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# Mariner's Compass.

R E C T I F I E D.



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T H E

# Mariner's Compass

R E C T I F I E D.

Containing TABLES, shewing the true Hour of the Day, the Sun being upon any Point of the Compass: With the true Time of the Rising and Setting of the Sun and Stars, and the Points of the Compass upon which they rise and set: With Tables of Amplitudes. Which Tables of Sun-dials, Semidiurnal Arches and Amplitudes are calculated from the Equator to 60 Degrees of Latitude, either North or South.

With the Description and Use of those Instruments most in Practice in the ART of NAVIGATION.

A L S O

A TABLE of LATITUDE and LONGITUDES  
of PLACES.

By ANDREW WAKELY, Mathematician.

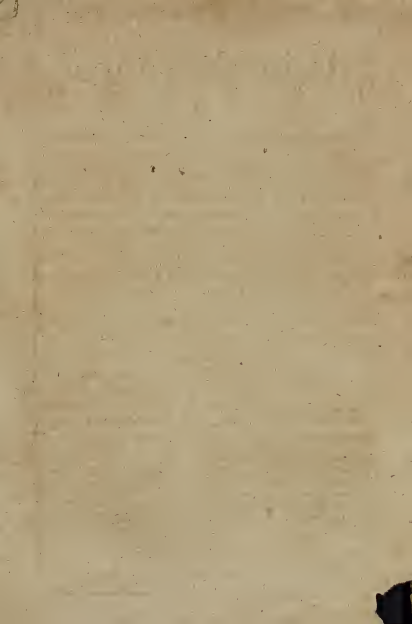
Enlarged with many useful Additions, by J. Atkinson.

The Whole revised, and carefully corrected, with accurate TABLES of the Sun's Declination, adjusted to the N.S.

By W. MOUNTAINE, Mathematical Examiner to the Hon. Corporation of Trinity-House of Deptford, and F.R.S.

L O N D O N : P R I N T E D

For J. MOUNT, T. PAGE, W. MOUNT, and T. PAGE, on  
Tower-hill; Where may be had all Sorts of Sea-Books, 1780.



T O T H E

# R E A D E R.

Courteous READER,

*W*HEN I first entered upon these my Labours, and after I had begun the Calculations, I found that though the Book would be small, yet my Labour was so great that I almost fainted. Yet, at Length, when I considered the ordinary, necessary, and frequent Use that might be made of these my Labours, I was thereby encouraged to go on and prosecute my Work; and how ready and easy I have made it for Practice, will plainly appear, by immediate Inspection, to the meanest Capacity.

Here follows a brief Explanation of the Method and Order of the Book: First, you will find Tables of the Sun's Declination, newly calculated from the best Hypothesis yet discovered, and applied to the Meridian of London, whose Latitude is 51d. 32m. North, and Longitude, according to these Tables, 00d. 00m.—Next you will find Tables, shewing the true Hour and Minute of the Day, the Sun being upon any Point of the Compass, which Tables are as Dials, fitting all Places in the World, whose Pole is elevated not above 60d. either North or South: Likewise by these Tables you may know the true Hour and Minute of the Night, by the Bearing of any of the known Fixed Stars between the Tropics: Then you will find Tables shewing the true Time of the Sun's Rising and Setting with the Length of the Day and Night. Also by these Tables

Tables you may find the true Time of Rising and Setting of all the eminent Fixed Stars between the Tropics. Next you will find Tables shewing the Point of the Compass that the Sun and all the abovesaid Stars rise and set upon; which Tables are of excellent Use for readily finding the Variation of the Compass, and may be performed by a Meridian Compass, that is about ten Inches in Diameter, whose Points are divided into Halves and Quarters; such a Compass I suppose to be convenient for a Mariner's Use, where he hath not an Azimuth Compass. Next you will find Tables of Amplitudes to every Degree of the Sun's Declination: All these Tables are calculated from the Equator to 60 Degrees of Latitude, either North or South: and they will last, with Exactness, as long as GOD upholdeth the Order and Course of Nature.

In the Appendix you will find the Use of all those Instruments that are most in Practice in the Art of NAVIGATION, either for Operation or Observation: Likewise a Table containing the most principal Harbours, Headlands, and Islands in the WORLD; shewing the Latitude and Longitude at each of them; beginning the Longitude at the Meridian of London; the Whole disposed in a new, and successive Order.

This Method, I own, but how I have acquitted myself therein, I shall leave to the Judgment and Experience of the most skilful Mariners that the World affords, which are my native Countrymen in England.

And now fare ever well, so wishes he,  
Who is more yours, than he can seem to be.

ANDREW WAKELY.

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To the P U B L I C.

S I R S,

**B**EING desired by the Booksellers concerned herein, I willingly undertook the Examination of this Treatise, (and the rather for that Respect I bear to the Testimony of my Master, the deceased Author) which, for its Usefulness, hath obtained good Esteem from our NAVIGATORS: I therefore have taken the greater Pains, and spent much Time in examining each Table, amending, altering, explaining, and enlarging where I saw Cause, and thus have endeavoured to render the Whole of the MARINER's COMPASS RECTIFIED, most familiar, and easy to an ordinary Capacity.

In this Edition I have contracted the *Table of Amplitudes in Points of the Compass*, and yet as intelligible as before, by which, having made more Room, I have made the Reader Amends with large Additions in the Use of each Table, and methodizing the Discourse throughout; but more especially in the *Use of Instruments*, I have taken Liberty to repair, alter, and enlarge, that it will appear as good as new; but chiefly in the *Description and Use of the Gunter, Sliding Gunter, and Sector*; principally the

two former, whose Uses I have shewed in *Arithmetic*, to *multiply, divide, and work* the RULE OF THREE; in *Geometry*, to work *Proportions, continued, Duplicate, and Triplicate*; *Mensuration of Superficies and Solids*: As to measure Board, Timber, Stone, Gauging of Vessels, Tunnaging of Ships, Bales, or Boxes; also in *Gunnery*; in *Navigation*, both in *Plane* and *Mercator's Sailing*. In *Astronomy*, the most useful Problems, such as to find the Sun's Place, Declination, Rising, Setting, Amplitude, Azimuth, Hour, and Altitude, at all Times. And in all you are directed plainly to perform them, both by Sliding Gunter and with Compasses.

In the *Table of Latitudes and Longitudes* I have added many Places of Note, and omitted some few that were of little Moment, and have corrected both the Latitudes and Longitudes of the most eminent, according to the latest Observations; so that I am bold to say, it is the most exact Table of the Kind extant.

These, with many other Additions through the Whole, I hope will acceptance with young Students in the Mathematics, and prove serviceable to them, both in the Study and Practice of Navigation, and other Parts of the Mathematics. For whose Sakes I have taken the greater Pains herein.

JAMES ATKINSON.

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T O T H E  
R E A D E R.

*I*N this Edition of the Mariner's Compass Rectified, all the Examples have been recalculated with the greatest Care, and properly adapted to subsequent Time; the Tables of the Sun's Declination, Amplitudes, Latitudes and Longitudes of Places, &c. have likewise been compared with, and careful corrected by the latest and most accurate Astronomic and Geographical Observations; to which is added (by way of Appendix) the Situation of the most essential Islands, &c. discovered during Capt. Cook's Voyage in his Majesty's Ship the Resolution and Adventure, towards the South Pole, and round the World, in the Years 1772, 1773, 1774 and 1775, the same established by Cælestial Observations. Those of the Sun's Declination are truly computed for the first four Years, and may very well serve in common Practice (without any sensible Error) for all those Years respectively superfix'd, or set at the Head of the Tables.

But if a greater Degree of Accuracy is required, the following Correction may be made at the End of eight Years, viz. from March 21<sup>st</sup> to May 21<sup>st</sup>, and from September 21<sup>st</sup> to November 21<sup>st</sup>, add one Minute to the Declination in these Tables found, and from July 21<sup>st</sup> to September 21<sup>st</sup>; also from January 21<sup>st</sup> to March 21<sup>st</sup>, subtract one Minute from the respective Declination; the Sum, or Difference will be the Declination at that Time corrected nearly. The

*First Year after Leap-Year.*

Sun's Declination 1781, 1785, 1789, 1793.

Days	Jan.		Feb.		March		April		May		June	
	South		South		South		North		North		North	
	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
1	22	58	16	55	07	20	04	47	15	15	22	09
2	22	52	16	37	06	57	05	10	15	35	22	17
3	22	46	16	19	06	34	05	33	15	51	22	24
4	22	40	16	01	06	11	05	56	16	08	22	31
5	22	33	15	43	05	48	06	19	16	25	22	38
6	22	26	15	25	05	25	06	41	16	42	22	44
7	22	18	15	06	05	01	07	04	16	59	22	50
8	22	10	14	47	04	38	07	26	17	15	22	55
9	22	01	14	27	04	14	07	48	17	31	23	00
10	21	52	14	08	03	51	08	11	17	47	23	05
11	21	43	13	48	03	27	08	33	18	02	23	09
12	21	33	13	28	03	04	08	54	18	17	23	12
13	21	22	13	08	02	40	09	16	18	32	23	16
14	21	12	12	47	02	16	09	38	18	46	23	19
15	21	01	12	27	01	53	09	59	19	11	23	21
16	20	49	12	06	01	29	10	20	19	14	23	24
17	20	37	11	45	01	05	10	41	19	20	23	25
18	20	25	11	24	00	42	11	02	19	41	23	27
19	20	12	11	02	00	18	11	23	19	54	23	28
20	19	59	10	41	Nor. 6		11	44	20	06	23	28
21	19	45	10	19	00	29	12	04	20	19	23	28
22	19	32	09	57	00	53	12	24	20	30	23	28
23	19	17	09	35	01	17	12	44	20	42	23	27
24	19	03	09	13	01	40	13	04	20	53	23	26
25	18	48	08	51	02	04	13	23	21	04	23	24
26	18	33	08	28	02	27	13	42	21	14	23	22
27	18	17	08	06	02	51	14	02	21	24	23	20
28	18	01	07	43	03	14	14	20	21	34	23	17
29	17	45			03	37	14	39	21	43	23	14
30	17	29			04	01	14	57	21	52	23	10
31	17	12			04	24			22	01		



*First after Leap-Year.*

Sun's Declination 1781, 1785, 1789, 1793.

Days	July		August		Sept.		Oct.		Nov.		Dec.	
	North		North		North		South		South		South	
	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
1	23	06	17	55	08	06	03	25	14	39	21	56
2	23	02	17	39	07	44	03	48	14	58	22	05
3	23	57	17	24	07	22	04	12	15	17	22	13
4	23	52	17	08	07	00	04	35	15	36	22	21
5	23	46	16	51	06	37	04	58	15	54	22	29
6	22	40	16	35	06	15	05	21	16	12	22	36
7	22	34	16	18	05	52	05	44	16	29	22	43
8	22	27	16	01	05	30	06	07	16	47	22	49
9	22	20	15	44	05	07	06	30	17	04	22	55
10	22	12	15	26	04	44	06	53	17	21	23	00
11	22	04	15	08	04	21	07	15	17	37	23	05
12	21	56	14	50	03	58	07	38	17	54	23	09
13	21	47	14	32	03	35	08	00	18	10	23	13
14	21	38	14	13	03	12	08	23	18	25	23	17
15	21	28	13	55	02	49	08	45	18	40	23	20
16	21	19	13	36	02	26	09	07	18	55	23	22
17	21	08	13	16	02	03	09	29	19	10	23	24
18	20	58	12	57	01	39	09	51	19	24	23	26
19	20	47	12	37	01	16	10	13	19	38	23	27
20	20	36	12	18	00	53	10	34	19	52	23	28
21	20	24	11	58	00	29	10	56	20	05	23	28
22	20	12	11	37	00	06	11	17	20	18	23	28
23	20	00	11	17	Sou	18	11	38	20	30	23	27
24	19	47	10	56	00	41	11	59	20	42	23	26
25	19	34	10	36	01	04	12	20	20	54	23	24
26	19	21	10	15	01	28	12	40	21	06	23	22
27	19	07	09	54	01	51	13	01	21	16	23	19
28	18	54	09	32	02	15	13	21	21	27	23	16
29	18	39	09	11	02	38	13	41	21	37	23	13
30	18	25	08	49	03	02	14	00	21	47	23	09
31	18	10	08	28			14	20			23	04

*Second Year after Leap-Year.*

Sun's Declination 1782, 1786, 1790, 1794.

Days	Jan.		Feb.		March		April		May		June	
	South		South		South		North		North		North	
	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
1	22	59	16	59	07	26	04	40	15	11	22	07
2	22	54	16	41	07	03	05	04	15	29	22	15
3	22	48	16	24	06	40	05	27	15	47	22	22
4	22	42	16	06	06	17	05	50	16	04	22	29
5	22	35	15	48	05	53	06	13	16	21	22	36
6	22	28	15	29	05	30	06	36	16	38	22	42
7	22	20	15	10	05	07	06	58	16	55	22	48
8	22	12	14	51	04	43	07	21	17	11	22	54
9	22	03	14	32	04	23	07	43	17	27	22	59
10	21	54	14	13	03	57	08	05	17	43	23	03
11	21	45	13	53	03	33	08	27	17	58	23	08
12	21	35	13	33	03	20	08	49	18	14	23	11
13	21	25	13	13	02	46	09	11	18	28	23	15
14	21	14	12	52	02	22	09	32	18	43	23	18
15	21	03	12	32	01	59	09	54	18	57	23	21
16	20	52	12	11	01	35	10	15	19	11	23	23
17	20	40	11	50	01	11	10	36	19	25	23	25
18	20	28	11	29	00	48	10	57	19	38	23	26
19	20	15	11	07	00	24	11	18	19	51	23	27
20	20	02	10	46	00	00	11	39	20	03	23	28
21	19	50	10	24	Nor. 24		11	59	20	16	23	28
22	19	35	10	02	00	47	12	19	20	29	23	28
23	19	21	09	40	01	11	12	39	20	38	23	27
24	19	07	09	18	01	34	12	59	20	50	23	26
25	18	52	08	56	01	58	13	18	21	00	23	25
26	18	37	08	34	02	22	13	38	21	12	23	23
27	18	21	08	11	02	44	13	57	21	22	23	21
28	18	05	07	48	03	08	14	16	21	32	23	18
29	17	49			03	32	14	35	21	41	23	15
30	17	33			03	55	14	53	21	50	23	11
31	17	16			04	18			21	59		

## Second after Leap-Year.

Sun's Declination 1782, 1786, 1790, 1794.

Days	July		August		Sept.		Oct.		Nov.		Dec.	
	North		North		North		South		South		South	
	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
1	23	07	17	59	08	11	03	19	14	34	21	54
2	23	03	17	43	07	49	03	43	14	54	22	03
3	22	58	17	28	07	27	04	06	15	12	22	11
4	22	53	17	12	07	05	04	29	15	31	22	19
5	22	47	16	55	06	43	04	52	15	49	22	27
6	22	42	16	39	06	20	05	15	16	07	22	34
7	22	35	16	22	05	58	05	38	16	25	22	41
8	22	28	16	05	05	35	06	01	16	43	22	47
9	22	21	15	48	05	13	06	24	17	00	22	53
10	22	14	15	30	04	50	06	47	17	17	22	59
11	22	06	15	13	04	27	07	10	17	33	23	04
12	21	58	14	55	04	04	07	32	17	50	23	08
13	21	49	14	36	03	41	07	55	18	06	23	12
14	21	40	14	18	03	18	08	17	18	21	23	16
15	21	31	14	00	02	55	08	40	18	37	23	19
16	21	21	13	40	02	32	09	02	18	52	23	22
17	21	11	13	21	02	08	09	24	19	07	23	24
18	21	01	13	02	01	45	09	46	19	21	23	26
19	20	50	12	42	01	22	10	07	19	35	23	27
20	20	39	12	22	00	58	10	29	19	49	23	28
21	20	27	12	02	00	35	10	51	20	02	23	28
22	20	15	11	42	00	12	11	12	20	15	23	28
23	20	03	11	22	Sou	12	11	33	20	27	23	27
24	19	50	11	01	00	35	11	54	20	40	23	26
25	19	38	10	41	00	59	12	15	20	51	23	25
26	19	24	10	20	01	22	12	35	21	03	23	23
27	19	11	09	59	01	46	12	56	21	14	23	20
28	18	57	09	37	02	09	13	16	21	25	23	17
29	18	43	09	16	02	33	13	36	21	35	23	14
30	18	28	08	55	02	56	13	56	21	45	23	10
31	18	14	08	33			14	15			23	06

*Third after Leap - Year.*

Sun's Declination, 1783, 1787, 1791, 1795.

Days	Jan.		Feb.		March		April		May		June	
	South		South		South		North		North		North	
	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
1	23	01	17	03	07	31	04	36	15	07	22	05
2	22	55	16	46	07	08	04	59	15	25	22	13
3	22	49	16	28	06	45	05	22	15	43	22	21
4	22	43	16	10	06	22	05	45	16	00	22	28
5	22	37	15	52	05	59	06	08	16	17	22	34
6	22	30	15	34	05	36	06	30	16	34	22	41
7	22	22	15	15	05	13	06	53	16	51	22	47
8	22	14	14	56	04	49	07	15	17	07	22	52
9	22	06	14	37	04	26	07	38	17	23	22	58
10	21	57	14	17	04	02	08	00	17	39	23	02
11	21	47	13	58	03	39	08	22	17	55	23	07
12	21	38	13	38	03	15	08	44	18	10	23	11
13	21	28	13	18	02	52	09	06	18	25	23	14
14	21	17	12	57	02	28	09	27	18	40	23	17
15	21	06	12	37	02	09	09	49	18	54	23	20
16	20	55	12	16	01	41	10	10	19	08	23	23
17	20	43	11	55	01	17	10	31	19	22	23	25
18	20	31	11	34	00	53	10	52	19	35	23	26
19	20	18	11	13	00	30	11	13	19	48	23	27
20	20	05	10	51	00	06	11	34	20	01	23	28
21	19	52	10	29	Nor. 18		11	54	20	13	23	28
22	19	38	10	08	00	42	12	14	20	25	23	28
23	19	24	09	46	01	05	12	34	20	36	23	27
24	19	10	09	24	01	29	12	54	20	48	23	26
25	18	55	09	01	01	52	13	14	20	59	23	25
26	18	40	08	39	02	16	13	33	21	09	23	23
27	18	25	08	16	02	39	13	52	21	20	23	21
28	18	09	07	54	03	03	14	11	21	29	23	19
29	17	53			03	26	14	30	21	39	23	16
30	17	37			03	49	14	49	21	48	23	12
31	17	20			04	13			21	57		

## Third after Leap - Year.

Sun's Declination, 1783, 1787, 1791, 1795.

Days	July		August		Sept.		Oct.		Nov.		Dec.	
	North		North		North		South		South		South	
	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
1	23	08	18	02	08	17	03	14	14	30	21	52
2	23	04	17	47	07	55	03	37	14	49	22	01
3	22	59	17	31	07	33	04	00	15	08	22	09
4	22	54	17	16	07	10	04	23	15	26	22	18
5	22	49	16	59	06	48	04	47	15	45	22	25
6	22	43	16	43	06	26	05	10	16	03	22	33
7	22	37	16	26	06	03	05	33	16	11	22	40
8	22	31	16	09	05	41	05	56	16	38	22	46
9	22	23	15	52	05	18	06	19	16	56	22	52
10	22	16	15	36	04	55	06	42	17	13	22	58
11	22	08	15	17	04	32	07	04	17	29	23	03
12	22	00	14	59	04	10	07	27	17	46	23	07
13	21	51	14	41	03	47	07	50	18	02	23	11
14	21	42	14	22	03	24	08	12	18	18	23	15
15	21	33	14	04	03	00	08	34	18	33	23	18
16	21	23	14	45	02	37	08	57	18	48	23	21
17	21	13	13	26	02	14	09	19	19	03	23	24
18	21	03	13	08	01	51	09	40	19	18	23	25
19	20	52	12	47	01	27	10	02	19	32	23	27
20	20	41	12	27	01	04	10	24	19	45	23	28
21	20	30	12	07	00	41	10	45	19	59	23	28
22	20	18	11	47	00	17	11	07	20	12	23	28
23	20	06	11	27	Sou. 06		11	28	20	24	23	28
24	19	53	11	06	00	30	11	49	20	37	23	27
25	19	41	10	46	00	53	12	10	20	49	23	25
26	19	28	10	25	01	17	12	30	21	00	23	23
27	19	14	10	04	01	40	12	51	21	11	23	21
28	19	02	09	43	02	04	13	01	21	22	23	18
29	18	46	09	21	02	27	13	31	21	32	23	15
30	18	32	09	00	02	50	13	51	21	42	23	11
31	18	17	08	38			14	10			23	07

*Leap - Year.*

Sun's Declination, 1780, 1784, 1788, 1792.

Days	Jan.		Feb.		March		April		May		June	
	South		South		South		North		North		North	
	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
1	23	02	17	07	07	14	04	59	15	21	22	11
2	22	57	16	50	06	51	05	16	15	38	22	19
3	22	51	16	32	06	28	05	39	15	56	22	26
4	22	45	16	15	06	05	06	02	16	13	22	33
5	22	38	15	57	05	42	06	25	16	30	22	39
6	22	31	15	38	05	18	06	47	16	47	22	45
7	22	24	15	20	04	55	07	10	17	03	22	51
8	22	16	15	01	04	31	07	32	17	20	22	56
9	22	08	14	41	04	08	07	55	17	36	23	01
10	21	59	14	22	03	44	08	17	17	51	23	06
11	21	50	14	02	03	21	08	39	18	06	23	10
12	21	40	13	43	02	57	09	00	18	21	23	14
13	21	30	13	23	02	34	09	22	18	36	23	17
14	21	20	13	02	02	10	09	44	18	51	23	20
15	21	09	12	42	01	46	10	05	19	05	23	22
16	20	58	12	21	01	23	10	26	19	18	28	24
17	20	46	12	00	00	59	10	47	19	32	22	26
18	20	34	11	39	00	35	11	08	19	45	23	27
19	20	21	11	18	00	12	11	29	19	58	23	28
20	20	09	10	56	Nor. 12		11	49	20	18	23	28
21	19	55	10	35	00	36	12	09	20	20	23	28
22	19	42	10	13	00	59	12	30	20	34	23	28
23	19	28	09	51	01	23	12	49	20	45	23	27
24	19	14	09	29	01	47	13	09	20	56	23	26
25	18	59	09	07	02	10	13	29	21	07	23	24
26	18	44	08	44	02	34	13	48	21	17	23	22
27	18	29	08	22	02	57	14	07	21	27	23	19
28	18	13	07	59	03	20	14	26	21	37	23	16
29	17	57	07	37	03	44	14	44	21	46	23	13
30	17	44			04	07	15	02	21	55	23	09
31	17	24			04	31			22	03		

*Leap - Year.*

Sun's Declination, 1780, 1784, 1788, 1792.

	July		August		Sept.		Oct.		Nov.		Dec.	
	North		North		North		South		South		South	
	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
1	23	05	17	51	08	00	03	31	14	44	21	59
2	23	01	17	35	07	38	03	55	15	03	22	07
3	22	56	17	19	07	16	04	18	15	22	22	16
4	22	50	17	03	06	54	04	41	15	40	22	24
5	22	45	16	47	06	31	05	04	15	59	22	31
6	22	38	16	50	06	09	05	27	16	17	22	38
7	22	33	16	13	05	46	05	50	16	34	22	45
8	22	25	15	56	05	24	06	13	16	52	22	51
9	22	18	15	39	05	01	06	36	17	09	22	56
10	22	10	15	21	04	38	06	59	17	25	23	02
11	22	02	15	03	04	15	07	21	17	42	23	06
12	21	53	14	45	03	52	07	44	17	58	23	11
13	21	45	14	27	03	29	08	06	18	14	23	14
14	21	35	14	08	03	06	08	29	18	29	23	18
15	21	26	13	19	02	45	08	51	18	45	23	21
16	21	16	13	30	02	20	09	13	19	00	23	23
17	21	06	13	11	01	56	09	35	19	14	23	25
18	20	55	12	52	01	33	09	57	19	28	23	27
19	20	44	12	32	01	10	10	19	19	42	23	27
20	20	33	12	12	00	46	10	40	19	56	23	28
21	20	21	11	52	00	23	11	02	20	09	23	28
22	20	09	11	32	00	00	11	23	20	21	23	28
23	19	57	11	11	Sou. 24		11	44	20	34	23	27
24	19	44	10	51	00	47	12	05	20	46	23	26
25	19	31	10	30	01	11	12	25	20	57	23	24
26	19	17	10	09	01	34	12	46	21	09	23	22
27	19	04	09	48	01	58	13	06	21	19	23	19
28	18	50	09	27	02	21	13	26	21	30	23	16
29	18	35	09	06	02	45	13	46	21	40	23	12
30	18	21	08	44	03	08	14	06	21	49	23	08
31	18	06	08	22			14	25			23	03

# A Description of the TABLES of the SUN's DECLINATION.

**T**HESE Tables are in general for Four Years; Leap-Year, First, Second and Third Year after Leap Year, and consequently for any Year.

Each Year (taking up two Pages) hath the first Six Months of the Year on the Left-hand Page, and the last six Months are on the Right-hand Page, the Names of the Months are at the Head of each Column, and the Days of each Month in the Left-hand Column of each Page.

The first Table sheweth the Sun's Declination every Day for the first Years after Leap-Year, being 1781, 1785, 1789, 1793, &c. and takes up Pages (10 and 11:) The second Table is for 1782, 1786, 1790, 1794, &c. being the second Year after Leap-Year in Pages (12) and (13): The next Table in Pages (14) (15) is for the Third Year after Leap-Year: The Fourth Table in Pages (16) and (17) sheweth the Sun's Declination for Leap-Years, being 1780, 1784, 1788, 1792, &c.

Under the Name of the Month, is the Name of the Declination either North or South, only the Column for March and September hath two Names; that is, under March is South, and against the 21st or 20th Day (according as it is Leap-Year, or 1st, 2d, 3d Year after) is Nor. for North; and under September is North, and against the 23d or 24th Day is Sou. for South; intimating that the Declination is South in March, till the 21st or 20th Day, and all the remaining Part of the Month it is North or Nor. in like manner in September, it is North till the 23d, or 24th Day, and from thence to the Months end it is South or Sou.

The



## The Use of the Tables of Declination.

**T**O find the Sun's Declination for any Day in any Year, is after this Manner.

1. Seek the Year and Month, at the Head of the Table; and the Day of the Month in the Left-hand Column.

2. Then right under the Month, at the Head of the Table, and against the Day of the Month in the Left-hand Column, is the Sun's Declination required.

*Example 1.* I desire to know the Sun's Declination for the 24th Day of April, 1782.

The Year 1782, is the second Year after Leap-Year, which is in Page (12); then under April, and against 24 (under Days) is 12.59, with North at the Head of the Table under April; which sheweth the Sun's Declination on the 24th of April, 1786, is 12d. 59m. North.

*Example 2.* What is the Sun's Declination of the 21st of March, 1780.

The Year 1780, being Leap-Year, is found in Page 16; then against the 21st Day, and under March, is Nor. 0.36; signifying the Sun's Declination at that Time is 0od. 36m. North; the like do for any other Time.

A TABLE to Proportion the Sun's Declination to any other Meridian.

		The daily Difference in Declination																			
East Long. Decl.	Incr. } Subt. } Decr. } Add.	West Long Dec.	Incr. } Add. } Decr. } Subt.	Degrees of Longitude.	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min
				m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
		15			0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
		30			0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2
		45			0	0	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3
		60			0	0	1	1	2	2	2	3	3	3	3	4	4	4	4	4	4
		75			0	1	1	2	2	2	3	3	4	4	4	5	5	5	5	5	5
		90			0	1	1	2	2	3	3	4	4	5	5	5	5	6	6	6	6
		105			1	1	2	2	3	3	4	5	5	6	6	6	6	7	7	7	7
		120			1	1	2	3	3	4	5	5	6	7	7	7	7	8	8	8	8
		135			1	1	2	3	4	4	5	6	7	7	8	8	8	9	9	9	9
		150			1	2	2	3	4	5	6	7	7	8	9	9	9	10	10	10	10
		165			1	2	3	4	5	5	6	7	8	9	9	10	10	11	11	11	11
		180			1	2	3	4	5	6	7	8	9	10	11	11	11	12	12	12	12

## The Use of this TABLE of Proportion.

THE Tables of the Sun's Declination are calculated for the Meridian of *London*, and will serve for any Place under that Meridian; but for those Places situate Easterly or West-erly from it, the Declination must be proportioned according to its daily Difference in the Table; and Longitude of those Places from the Meridian of *London*; for which Purpose this Table is useful, as is evident by these Examples.

Example

Example 1.

Admit the 10th Day of April, Anno 1782, I am in Longitude 105d. East; I demand what Declination the Sun will have that Day in the Meridian of that Place?

The Declination for April the 10th, in the Meridian of London is 08d. 05m. increasing, and the daily Difference at that Time is 22m. therefore in this Table look in the Head thereof for the Number 22, or nearest thereunto, if not in the Table; then look on the Left-hand of the Table for 105d. (or the nearest thereto) the Longitude I am in, and in the common Angle of meeting is 6 Min. which is to be deducted from the Declination in the Meridian of London aforesaid 8d. 05m. and the Remainder will be the Declination for that Meridian, or the Longitude I am in, which is 08d. 58m. North. But if the Declination has decreased, as it doth here increase, then you must have added, as hereunder you may see.

The Declination in the Meridian of London is 08 : 05N.

The proportional Minutes subtract ———— 00 : 06

The Decl. for the Longitude of 105d. East is 07 : 59N.

The Decl. for the Longitude of 105d. West is 08 : 11

Example 2.

Admit the 10th Day of October, Anno 1780, I am in Longitude 87d. West: I demand what Declination the Sun will have that Day in that Meridian?

The daily Difference in the Table of Declination at this Time is 23m. and the proportional Part thereof by the last Table is 5 min. increasing.

The Declination in the Meridian of London — 06 : 59 S

The proportional Minutes add ———— 00 : 05

The Declination in the Long. of 87d. West is 06 : 04 S

The Declination for the Long. of 87d. East is 06 : 54 S



A TABLE of Refraction, deduced from Mr. Flamsteed's Observations, made at the Royal Observatory at Greenwich.

Altitudes.	Refract.	Altitudes.	Refract.	Altitudes.	Refract.	Altitudes.	Refract.
D.	M.S.	D.	M.S.	D.	M.S.	D.	M.S.
00	33.00	10	4.13	25	1.47	40	0.58
00 $\frac{1}{2}$	26.38	11	4.16	26	1.40	41	0.56
01	23.22	12	3.55	27	1.36	42	0.54
01 $\frac{1}{2}$	20.17	13	3.39	28	1.31	43	0.52
02	17.26	14	3.23	29	1.27	44	0.50
02 $\frac{1}{2}$	15.15	15	3.00	30	1.23	45	0.48
03	13.23	16	2.58	31	1.20	46	0.46
03 $\frac{1}{2}$	11.53	17	2.48	32	1.17	47	0.45
04	10.39	18	2.39	33	1.14	48	0.44
04 $\frac{1}{2}$	9.38	19	2.31	34	1.11	49	0.42
05	8.48	20	2.24	35	1.09	50	0.40
06	7.47	21	2.11	36	1.07	55	0.35
07	6.45	22	2.01	37	1.05	60	0.30
08	5.57	23	2.00	38	1.02	70	0.19
09	5.22	24	1.50	39	1.00	80	0.10
10	4.43	25	1.47	40	1.58	90	0.00

The Refraction of the Sun, Moon and Stars, causeth them to appear higher above the Horizon then they are; therefore the Refraction is always to be subtracted from the Altitude observed, that the true Altitude may be had.

As, admit the Sun's Meridian Altitude, by Observation, to be 5 Degrees; I demand the true Altitude.

	d.	m.
Altitude by Observation being - - - - -	05	: 00
Sun's Refraction 8 m. 58 f. subtract - - - - -	00	: 09

The Sun's true Meridian Altitude is - - - - - 04 : 51

Primum



# *PRIMUM MOBILE :*

O R,

## Astronomic Tables ;

Each TABLE being

## A S U N - D I A L,

S H E W I N G

The exact Hour of the Day, the Sun being upon any Point of the Compass ; fitting all Places upon the Earth and Sea, that lie between the Equator and 60 Degrees of Latitude, either North or South : And to last with Exactness as long as the Omnipotent and Everlasting Creator shall be pleased to conserve the great and wonderful Fabric of Nature.

A Sun-Dial for the Latitude of 0 Degree.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
	om	om	om	om	om	om	om	om	om	om	om
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
North	12	12	12	12	12	12	12	12	12	12	12
n by w	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.17	0.19	0.20	0.20
n n w	0.04	0.08	0.12	0.17	0.21	0.25	0.30	0.35	0.39	0.41	0.41
nw by n	0.07	0.13	0.20	0.27	0.34	0.41	0.49	0.56	1.03	1.07	1.07
n. w	0.10	0.20	0.30	0.41	0.51	1.02	1.14	1.25	1.35	1.43	1.43
nw by w	0.15	0.30	0.45	1.01	1.18	1.35	1.53	2.12	2.29	2.42	2.42
w n w	0.24	0.49	1.14	1.41	2.09	2.41	3.18	4.06	5.11		
w by n	0.51	1.44	2.41	4.10							
West											
☉ set	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Sun's	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
Ampl.	0 00	2 30	5 00	7 30	1 00	12 30	15 00	17 30	20 00	22 00	23 20

## SOUTH DECLINATION.

[illegible]

A Sun-Dial for the Latitude of 1 Degree.

## NORTH DECLINATION.

[illegible]

## SOUTH DECLINATION.

[illegible]

## A Sun-Dial for the Latitude of 2 Degrees.

## NORTH DECLINATION.

o d	Deg. Min.	2 d 3om	5 d 3om	7 d 3om	10 d 3om	12 d 3om	15 d 3om	17 d 3om	20 d 3om	22 d 3om	23 d 29m
h m	Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
12	North	12	12	12	12	12	12	12	12	12	12
0.02	n by w	Zen. West.	0.02	0.04	0.06	0.09	0.11	0.13	0.15	0.17	0.18
0.03	n n w		0.05	0.09	0.13	0.18	0.22	0.27	0.32	0.35	0.38
0.05	nw by n		0.08	0.15	0.22	0.29	0.36	0.44	0.51	0.57	1.02
0.08	n w		0.12	0.22	0.33	0.43	0.54	1.05	1.17	1.27	1.34
0.12	nw byw		0.28	0.33	0.49	1.05	1.22	1.40	2.00	2.16	2.29
0.20	w n w		0.29	0.55	1.21	1.50	2.21	2.58	3.45	4.46	
0.40	w by n		1.03	2.03	3.23						
6.00	West										
6.00	☉ fet	6.00	6.00	6.00	5.01	6.02	6.02	6.02	6.03	6.03	6.04
d m	Sun's	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
0.00	Ampl.	2.30	5.00	7.30	10.0	12.30	15.0	17.31	20.0	22.1	23.30

## SOUTH DECLINATION.

Deg. Min.	o d	2 d 3om	5 d 3om	7 d 3om	10 d 3om	12 d 3om	15 d 3om	17 d 3om	20 d 3om	22 d 3om	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18	0.20	0.22
s s w	0.03	0.07	0.12	0.16	0.20	0.25	0.29	0.34	0.38	0.42	0.45
sw by s	0.05	0.12	0.19	0.25	0.32	0.39	0.46	0.54	1.01	1.08	1.12
s w	0.08	0.18	0.28	0.38	0.48	0.59	1.10	1.21	1.33	1.42	1.50
sw by w	0.12	0.27	0.42	0.57	1.13	1.29	1.46	2.04	2.23	2.40	2.53
w s w	0.20	0.43	1.08	1.33	2.00	2.28	3.00	3.36	4.24	5.24	
w by s	0.40	1.30	2.22	3.22	4.43						
West	5.00										
☉ fet	5.00	6.00	6.00	5.59	5.59	5.58	5.58	5.58	5.57	5.57	5.56



## A Sun-Dial for the Latitude of 3 Degrees.

## NORTH DECLINATION.

o d	Deg. Min.	2 d 30m	5 d 30m	7 d 30m	10 d	12 d 30m	15 d	17 d 30m	20 d	22 d	23 d 29m
h m	Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
12	North	12	12	12	12	12	12	12	12	12	12
0.02	n by w	Zen. West.	0.02	0.04	0.06	0.07	0.10	0.12	0.14	0.16	0.17
0.05	n n w		0.03	0.07	0.12	0.16	0.20	0.25	0.29	0.31	0.36
0.08	n w b n		0.05	0.12	0.19	0.26	0.33	0.40	0.48	0.54	0.59
0.12	n w		0.08	0.18	0.29	0.39	0.50	1.01	1.13	1.23	1.31
0.18	n w by w		0.12	0.27	0.43	0.59	1.16	1.34	1.54	2.10	2.24
0.29	w n w		0.20	0.45	1.11	1.39	2.11	2.47	3.33	4.33	
0.59	w by n		0.42	1.40	2.57						
6.00	West										
6.00	☉ set	6.00	6.00	6.01	6.02	6.02	6.03	6.04	6.04	6.05	6.05
d m	Sum's	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
0.00	Ampl.	2.30	5.00	7.30	10.1	11.31	15.1	17.31	20.2	22.2	23.32

## SOUTH DECLINATION.

Deg. Min.	o d	2 d 30m	5 d 30m	7 d 30m	10 d	12 d 30m	15 d	17 d 30m	20 d	22 d	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.02	0.05	0.07	0.09	0.11	0.13	0.15	0.17	0.19	0.21	0.21
s s w	0.05	0.09	0.13	0.18	0.22	0.26	0.31	0.35	0.40	0.44	0.47
sw by s	0.08	0.15	0.21	0.28	0.35	0.42	0.49	0.56	1.04	1.10	1.15
s w	0.12	0.22	0.32	0.42	0.53	1.03	1.14	1.25	1.37	1.47	1.55
sw by w	0.18	0.33	0.48	1.03	1.19	1.35	1.52	2.10	2.30	2.45	3.00
w s w	0.29	0.53	1.17	1.42	2.09	2.37	3.09	3.45	4.32	5.31	
w by s	0.55	1.48	2.40	3.38	4.55						
West	6.00										
☉ set	6.00	6.00	6.00	5.59	5.58	5.58	5.57	5.56	5.56	5.55	5.5

## A Sun-Dial for the Latitude of 4 Degrees.

## NORTH DECLINATION.

Deg Min	2 d 30m	Deg. Min	5 d 30m	7 d 30m	10 d 30m	12 d 30m	15 d	17 d om	20 d	22 d	23 d 29m
Point	h m	Point	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	North	12	12	12	12	12	12	12	12	12
s by w	0.01	n by w	0.01	0.03	0.05	0.07	0.09	0.11	0.13	0.15	0.17
s s w	0.02	n n w	0.02	0.06	0.10	0.14	0.19	0.23	0.28	0.32	0.35
sw by s	0.04	nw by w	0.03	0.09	0.16	0.23	0.30	0.38	0.45	0.52	0.57
s w	0.05	nw	0.04	.14	0.24	0.35	0.46	0.57	1.09	1.19	1.27
sw by w	0.09	nw by n	0.06	0.21	0.31	0.53	1.10	1.28	1.47	2.04	2.17
ws w	0.14	w n w	0.10	0.35	1.01	1.29	2.00	2.36	3.21	4.17	
w by s	0.29	w by n	0.21	1.17	2.29						
West	3.25	West									
☉ fet	6.00	☉ fet	6.01	6.02	6.03	6.03	6.04	6.05	6.06	6.06	6.07
Sun's Ampl.	d m 2.30	Sun's Ampl.	d m 5.00	d m 7.31	d m 10.1	d m 12.31	d m 15.2	d m 17.3	d m 20.3	d m 22.3	d m 23.33

## SOUTH DECLINATION

Deg. Min.	1 d 30m	2 d 30m	5 d 30m	7 d 30m	10 d 30m	12 d 30m	15 d	17 d 30m	20 d	22 d	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.05	0.07	0.07	0.09	0.11	0.13	0.16	0.18	0.20	0.22	0.23
s s w	0.07	0.11	0.15	0.19	0.23	0.28	0.32	0.36	0.41	0.45	0.48
sw by s	0.11	0.17	0.24	0.31	0.38	0.45	0.52	0.59	1.07	1.13	1.18
s w	0.16	0.21	0.36	0.46	0.56	1.07	1.18	1.20	1.41	1.51	1.58
sw by w	0.24	0.39	0.54	1.09	1.21	1.41	1.58	2.15	2.35	2.51	3.04
ws w	0.38	1.02	1.26	1.51	2.17	2.45	3.17	3.52	4.38	5.33	
w by s	1.17	2.05	2.55	3.51	5.04						
West	6.00										
☉ fet	6.00	6.00	5.5	5.58	5.57	5.57	5.56	5.55	5.54	5.54	5.53

## A Sun-Dial for the Latitude of 5 Degrees.

## NORTH DECLINATION.

Deg Min	0 d	Deg. Min.	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	Point	30m	30m	h m	h m	30m	30m	h m	h m	29m
South	12	North	12	12	12	12	12	12	12	12	12
s by w	0.02	n by w	Zen. West.	0.02	0.01	0.06	0.08	0.10	0.12	0.14	0.16
s s w	0.04	n n w		0.04	0.08	0.13	0.18	0.22	0.26	0.30	0.33
sw by s	0.07	nw by n		0.07	0.14	0.21	0.28	0.35	0.43	0.49	0.54
s w	0.10	n w		0.1	0.20	0.31	0.42	0.53	1.05	1.15	1.22
sw byw	0.16	nwbw		0.15	0.31	0.47	1.04	1.21	1.40	1.57	2.10
w s w	0.24	w n w		0.25	0.51	1.18	1.49	2.24	3.08	4.00	
w by s	0.48	w by n		0.54	2.01						
West	4.00	West									
☉ fet	6.01	☉ fet	6.02	6.03	6.04	5.04	6.05	6.06	6.07	6.08	6.09
Sun's Ampl	d m 2.30	Sun's Amp	d m 5.01	d m 7.31	d m 10.2	d m 12.32	d m 15.2	d m 17.32	d m 20.5	d m 2.5	d m 13.35

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	29m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18	0.20	0.22	0.24
s s w	0.08	0.12	0.17	0.21	0.25	0.29	0.34	0.38	0.43	0.47	0.50
sw by s	0.13	0.20	0.27	0.33	0.40	0.47	0.54	1.02	1.09	1.16	1.21
s w	0.20	0.30	0.40	0.50	1.00	1.11	1.22	1.33	1.45	1.55	2.07
w by w	0.30	0.45	1.00	1.15	1.31	1.46	2.03	2.21	2.40	2.56	3.11
w s w	0.48	1.11	1.35	2.00	2.26	2.53	3.24	3.59	4.40	5.35	
w by s	1.35	2.21	3.09	4.03	5.11						
West	6.00										
☉ fet	6.00	5.59	5.58	5.57	5.56	5.56	5.55	5.54	5.53	5.52	5.51

## A Sun-Dial for the Latitude of 6 Degrees.

## NORTH DECLINATION.

Deg. Min.	2 d 30m	5 d	Deg. Min.	7 d 30m	10 d	12 d 30m	15 d	17 d 30m	20 d	22 d	23 d 29m
Point	h m	h m	Point	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	North	12	12	12	12	12	12	12	12
s by w	0.03	0.01	n by w	0.01	0.03	0.05	0.07	0.09	0.12	0.13	0.15
s s w	0.06	0.02	n n w	0.03	0.07	0.11	0.15	0.20	0.25	0.28	0.31
sw by s	0.09	0.0	nw by w	0.04	0.11	0.18	0.25	0.32	0.40	0.46	0.51
s w	0.14	0.04	nw	0.06	0.16	0.27	0.38	0.49	1.01	1.10	1.18
sw by w	0.21	0.06	nw by n	0.09	0.25	0.41	0.57	1.15	1.34	1.50	2.04
ws w	0.33	0.09	w n w	0.15	0.40	1.08	1.38	2.12	2.55	3.44	
w by s	1.06	0.20	w by n	0.32	1.34	3.24					
West	4.22	2.15	West								
☉ set	6.01	6.02	☉ set	6.03	5.04	6.05	6.06	6.07	6.09	6.10	6.11
Sun's Ampl.	d m	d m	Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m
	2.30	5.01		7.32	10.3	12.34	15.5	17.36	20.6	22.7	23.27

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d 30m	5 d	7 d 30m	10 d	12 d 30m	15 d	17 d 30m	20 d	22 d	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.05	0.07	0.09	0.11	0.13	0.15	0.17	0.19	0.21	0.23	0.24
s s w	0.10	0.14	0.18	0.22	0.27	0.31	0.35	0.40	0.44	0.48	0.51
sw by s	0.16	0.23	0.29	0.36	0.43	0.50	0.57	1.04	1.12	1.18	1.23
s w	0.24	0.34	0.44	0.54	1.04	1.15	1.25	1.37	1.48	1.58	2.06
sw by w	0.36	0.50	1.05	1.20	1.36	1.52	2.08	2.26	2.45	3.01	3.15
ws w	0.57	1.20	1.44	2.08	2.34	3.01	3.31	4.06	4.48	5.37	
w by s	0.51	2.35	5.22	4.13	5.16						
West	6.00										
☉ set	6.00	5.59	5.58	5.57	5.56	5.55	5.54	5.53	5.51	5.50	5.49

## A Sun-Dial for the Latitude of 7 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	5 d	Deg. Min.	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	Point	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	North	12	12	12	12	12	12	12	12
s by w	0.04	0.02	n by w	0.00	0.02	0.04	0.07	0.09	0.11	0.13	0.14
s s w	0.07	0.03	n n w	0.01	0.05	0.09	0.14	0.18	0.23	0.27	0.30
sw by s	0.12	0.05	nw by n	0.01	0.08	0.15	0.22	0.29	0.37	0.44	0.48
s w	0.18	0.08	n w	0.02	0.12	0.23	0.33	0.45	0.56	1.06	1.14
sw by w	0.27	0.12	nwbw	0.03	0.18	0.34	0.51	1.08	1.27	1.43	1.57
w s w	0.43	0.19	w n w	0.05	0.31	0.55	1.27	2.00	2.42	3.28	
w by s	1.23	0.39	w by n	0.10	1.08	2.36					
West	4.37	2.58									
w by n											
w n w											
☉ fet	6.01	6.02	☉ fet	6.03	6.05	6.06	6.08	6.09	6.10	6.11	6.12
Sun's Ampl.	d m	d m	Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m
	2.31	5.02		7.33	10.2	12.35	15.7	17.38	20.9	22.10	23.40

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
			30m		30m		30m		30m		29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.06	0.07	0.05	0.11	0.13	0.16	0.18	0.20	0.22	0.24	0.25
s s w	0.12	0.16	0.20	0.24	0.28	0.33	0.37	0.41	0.46	0.50	0.53
sw by s	0.19	0.25	0.32	0.39	0.45	0.52	0.59	1.07	1.15	1.21	1.25
s w	0.28	0.38	0.48	0.58	1.08	1.18	1.29	1.40	1.52	2.02	2.09
w by w	0.41	0.56	1.11	1.26	1.41	1.57	2.14	2.31	2.50	3.07	3.19
w s w	1.06	1.29	1.52	2.16	2.41	3.08	3.38	4.12	4.52	5.39	
w by s	2.06	2.49	3.33	4.22	5.20						
West	6.00										
☉ fet	6.00	5.59	5.58	5.57	5.55	5.54	5.52	5.51	5.50	5.49	5.48

## A Sun-Dial for the Latitude of 8 Degrees.

## NORTH DECLINATION.

Min. Deg.	2 d	5 d	7 d	Deg. Min.	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	Point	h m	h m	h m	h m	h m	m h	h m
South	12	12	12	North	12	12	12	12	12	12	12
s by w	0.04	0.02	0.00	n by w	0.02	0.04	0.06	0.08	0.10	0.12	0.13
s s w	0.09	0.05	0.01	n n w	0.03	0.08	0.12	0.16	0.21	0.25	0.26
sw by s	0.15	0.08	0.01	nw by w	0.05	0.12	0.20	0.27	0.34	0.41	0.45
s w	0.22	0.12	0.02	n w	0.08	0.18	0.29	0.40	0.52	1.02	1.09
sw by w	0.33	0.18	0.03	nw by w	0.12	0.28	0.45	1.02	1.20	1.35	1.49
w s w	0.52	0.25	0.05	w n w	0.20	0.46	1.16	1.48	2.28	3.11	4.06
w by s	1.39	0.56	0.10	w by n	0.44	0.59					
West	4.48	3.26	1.22	West							
☉ set	6.01	6.03	6.04	☉ set	6.06	6.07	6.09	6.10	6.12	6.13	9.14
Sun's Ampl.	d m	d m	d m	Sun's Amp.	d m	d m	d m	d m	d m	d m	d m
	2.31	5.02	7.34		10.6	12.38	15.5	17.40	20.11	22.13	23.45

## SOUTH DECLINATION

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 p	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	n m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.06	0.08	0.10	0.12	0.14	0.16	0.18	0.21	0.23	0.25	0.26
s s w	0.13	0.17	0.21	0.26	0.30	0.34	0.38	0.43	0.47	0.51	0.54
sw by s	0.21	0.28	0.34	0.41	0.48	0.55	1.02	1.09	1.17	1.23	1.28
s w	0.32	0.41	0.51	1.01	1.11	1.22	1.33	1.44	1.55	2.05	2.13
sw by w	0.47	1.02	1.16	1.31	1.46	2.02	2.19	2.36	2.55	3.09	3.22
w s w	1.14	1.37	2.00	2.24	2.48	3.15	3.44	4.17	4.56	5.30	
w by s	2.20	3.01	3.44	4.30	5.24						
West	6.00										
☉ set	6.00	5.55	5.57	5.56	5.54	5.53	5.51	5.50	5.48	5.47	5.46

## A Sun-Dial for the Latitude of 9 Degrees.

## NORTH DECLINATION.

Deg. Min.	2 d 30m	5 d	7 d 30m	Deg. Min.	10 d	12 d 30m	15 d	17 d 30m	20 d	22 d	23 d 29m
Point	h m	h m	h m	Point	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	North	12	12	12	12	12	12	12
s by w	0.05	0.01	0.01	n by w	0.01	0.03	0.05	0.07	0.09	0.11	0.12
s s w	0.11	0.07	0.03	n n w	0.02	0.06	0.10	0.14	0.19	0.23	0.26
sw by s	0.17	0.11	0.04	nw by n	0.03	0.10	0.17	0.24	0.31	0.38	0.43
s w	0.26	0.16	0.06	n w	0.04	0.14	0.25	0.36	0.47	0.57	1.05
sw by w	0.38	0.24	0.09	nw by w	0.06	0.22	0.38	0.55	1.13	1.30	1.42
w s w	1.00	0.38	0.14	w n w	0.10	0.36	1.04	1.36	2.15	2.55	3.42
w by s	1.53	1.13	0.29	w by n	0.21	1.2					
West	4.56	3.46	2.15			7					
☉ set	6.01	6.03	6.04	☉ set	6.06	6.08	6.10	6.12	6.14	6.15	6.16
Sun's Amp.	d m	d m	d m	Sun's Amp.	d m	d m	d m	d m	d m	d m	d m
	2.31	5.03	7.35		10.7	12.39	15.11	17.43	20.16	22.18	23.50

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d 30m	10 d	12 d 30m	15 d	17 d 30m	20 d	22 d	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.07	0.09	0.11	0.13	0.15	0.17	0.19	0.21	0.23	0.25	0.26
s s w	0.15	0.19	0.23	0.27	0.31	0.36	0.40	0.44	0.49	0.52	0.56
sw by s	0.24	0.30	0.37	0.44	0.50	0.57	1.04	1.12	1.19	1.25	1.31
s w	0.36	0.45	0.55	1.05	1.15	1.26	1.36	1.47	1.59	2.09	2.16
sw by w	0.53	1.07	1.22	1.36	1.52	2.07	2.24	2.41	2.59	3.14	3.28
w s w	1.23	1.45	2.08	2.31	2.55	3.21	3.50	4.22	5.00	5.40	
w by s	2.33	3.12	2.53	4.35	5.27						
West	6.00										
☉ set	6.00	5.59	5.57	5.56	5.54	5.52	5.50	5.48	5.46	5.45	5.44

## A Sun-Dial for the Latitude of 10 Degrees.

## NORTH DECLINATION.

Min. Deg.	2 d 30m	5 d 30m	7 d 30m	10 d	Deg. Min.	12 d 30m	15 d	17 d 30m	20 d	22 d	23 d 29m
Point	h m	h m	h m	h m	Point	h m	h m	h m	h m	h m	h m
South	12	12	12	12	North	12	12	12	12	12	12
s by w	0.06	0.04	0.02	Zen. West.	n by w	0.02	0.04	0.06	0.08	0.10	0.12
s s w	0.12	0.08	0.04		n n w	0.04	0.09	0.13	0.18	0.21	0.24
sw by s	0.20	0.13	0.07		nw by n	0.07	0.14	0.21	0.29	0.35	0.40
s w	0.30	0.20	0.10		n w	0.10	0.21	0.32	0.43	0.53	1.00
sw by w	0.44	0.30	0.15		nw by w	0.15	0.32	0.49	1.06	1.23	1.35
w s w	1.09	0.47	0.24		w n w	0.25	0.53	1.24	2.01	2.39	3.19
w by s	2.07	1.28	0.47		w by n	0.59	1.07				
West	5.03	4.01	2.47		West						
☉ fet	6.02	6.04	6.05	6.07	☉ fet	6.09	6.11	6.13	6.15	6.16	6.17
Sun's Ampl.	d m	d m	d m	d m	Sun's Amp.	d m	d m	d m	d m	d m	d m
	2.32	5.05	7.37	10.10		12.42	15.15	17.47	20.20	22.22	23.54

## SOUTH DECLINATION

Deg. Min.	0 d	2 d 30m	5 d	7 d 30m	10 d	12 d 30m	15 d	17 d 30m	20 d	22 d	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.08	0.10	0.12	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.27
s s w	0.16	0.21	0.25	0.29	0.33	0.37	0.42	0.46	0.51	0.54	0.57
sw by s	0.26	0.33	0.40	0.46	0.53	1.00	1.07	1.14	1.22	1.28	1.33
s w	0.39	0.49	0.59	1.09	1.19	1.29	1.40	1.51	2.02	2.12	2.19
sw by w	0.58	1.13	1.27	1.42	1.57	2.12	2.28	2.45	3.03	3.19	3.32
w s w	1.31	1.53	2.15	2.38	3.02	3.27	3.55	4.26	5.03	5.41	
w by s	2.44	3.22	4.01	4.42	5.29						
West	6.00										
☉ fet	6.00	5.58	5.56	5.55	5.53	5.51	5.49	5.47	5.45	5.44	5.43



## A Sun-Dial for the Latitude of 11 Degrees

## NORTH DECLINATION.

Deg. Min.	2 d	5 d	7 d	10 d	Deg. Min.	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	Point	h m	h m	h m	h m	h m	h m
South	12	12	12	12	North	12	12	12	12	12	12
s by w	0.07	0.05	0.03	0.01	s by w	0.01	0.03	0.05	0.07	0.09	0.11
s s w	0.14	0.10	0.06	0.02	n n w	0.02	0.07	0.11	0.16	0.20	0.22
sw by s	0.22	0.16	0.09	0.03	nw by n	0.04	0.11	0.18	0.26	0.32	0.37
s w	0.34	0.24	0.14	0.04	n w	0.06	0.17	0.28	0.39	0.49	0.56
sw by w	0.50	0.35	0.21	0.06	nwb w	0.09	0.25	0.42	1.00	1.15	1.28
w s w	1.17	0.56	0.33	0.10	w n w	0.15	0.41	1.12	1.47	2.23	2.59
w by s	2 19	1.43	1.03	0.20	w by n	0.33	1.55				
West	5 08	4.13	3.09	1.40							
☉ fet	6.02	6.04	6.06	6.08	☉ fet	5.10	6.12	6.14	6.16	6.18	6.19
Sun's Ampl.	d m	d m	d m	d m	Sun's Amp.	d m	d m	d m	d m	d m	d m
	2.32	5.05	7.38	10.11		12.44	15.17	17.50	20.24	22.27	23.59

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
North	12	12	12	12	12	12	12	12	12	12	12
s by w	0.09	0.11	0.13	0.15	0.17	0.19	0.21	0.23	0.25	0.27	0.28
s s w	0.18	0.22	0.26	0.30	0.34	0.39	0.43	0.47	0.52	0.56	0.59
sw by s	0.29	0.36	0.42	0.49	0.55	1.02	1.09	1.16	1.24	1.30	1.35
s w	0.43	0.53	1.03	1.12	1.22	1.33	1.43	1.54	2.05	2.15	2.22
sw by w	1.04	1.18	1.32	1.47	2.01	2.17	2.33	2.49	3.07	3.23	3.35
w s w	1.39	2.01	2.22	2.45	3.08	3.33	4.00	4.30	5.05	5.41	
w by s	2.55	3.31	4.08	4.47	5.31						
West	6.00										
☉ fet	6.00	5.58	5.56	5.54	5.52	5.50	5.48	5.46	5.44	5.42	5.41

## A Sun-Dial for the Latitude of 12 Degrees.

## NORTH DECLINATION.

Deg. Min.	2 d 30m	5 d 30m	7 d 30m	10 d 30m	Deg. Min.	12 d 30m	15 d 30m	17 d 30m	20 d 30m	22 d 30m	23 d 29m
Point	h m	h m	h m	h m	Point	h m	h m	h m	h m	h m	h m
South	12	12	12	12	North	12	12	12	12	12	12
s by w	0.07	0.06	0.04	0.02	n by w	0.00	0.02	0.04	0.07	0.09	0.10
s s w	0.16	0.12	0.08	0.04	n n w	0.01	0.05	0.10	0.14	0.18	0.21
sw by s	0.25	0.19	0.12	0.05	nw by n	0.01	0.08	0.15	0.23	0.29	0.34
s w	0.37	0.28	0.18	0.08	n w	0.02	0.12	0.23	0.35	0.44	0.51
sw by w	0.55	0.41	0.27	0.12	nw by w	0.03	0.19	0.35	0.53	1.09	1.21
w s w	1.25	1.04	0.42	0.19	w n w	0.05	0.31	1.00	1.34	2.07	2.40
w by s	2.31	1.56	1.19	0.38	w by n	0.11	1.17				
West	5.12	4.23	3.27	2.16							
☉ fet	6.02	5.04	4.06	3.09	☉ fet	6.11	6.13	6.15	6.18	6.20	6.21
Sun's Ampl.	d m	d m	d m	d m	Sun's Ampl.	d m	d m	d m	d m	d m	d m
	2.33	5.07	7.40	10.13		12.48	15.20	17.54	20.28	22.31	24.5

## SOUTH DECLINATION

Deg. Min.	0 d	2 d 30m	5 d 30m	7 d 30m	10 d 30m	12 d 30m	15 d 30m	17 d 30m	20 d 30m	22 d 30m	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.09	0.11	0.13	0.15	0.17	0.19	0.21	0.23	0.25	0.27	0.29
s s w	0.20	0.24	0.28	0.32	0.36	0.40	0.44	0.49	0.53	1.57	1.00
sw by s	0.31	0.38	0.45	0.51	0.58	1.05	1.12	1.19	1.26	1.32	1.37
s w	1.47	0.56	1.06	1.16	1.26	1.36	1.46	1.57	2.08	2.18	2.25
sw by w	1.09	1.23	1.37	1.52	2.06	2.21	2.37	2.53	3.11	3.27	3.39
w s w	1.47	2.07	2.29	2.51	3.14	3.38	4.04	4.33	5.07	5.41	
w by s	3.05	3.39	4.14	4.51	5.32						
West	6.00										
☉ fet	6.00	5.58	5.56	5.54	5.51	5.49	5.47	5.45	5.42	5.40	5.39

## A Sun-Dial for the Latitude of 13 Degrees

## NORTH DECLINATION.

Deg. Min.	2 d	5 d	7 d	10 d	12 d	Deg. Min.	15 d	17 d	20 d	22 d	23 d
		30m	30m		30m			30m			29m
Point	h m	h m	h m	h m	h m	Point	h m	h m	h m	h m	h m
South	12	12	12	12	12	North	12	12	12	12	12
s by w	0.08	0.06	0.04	0.02	0.00	n by w	0.02	0.04	0.06	0.08	0.09
s s w	0.17	0.13	0.09	0.05	0.01	n n w	0.03	0.08	0.12	0.16	0.19
sw by s	0.28	0.21	0.15	0.08	0.01	nw by n	0.06	0.13	0.20	0.26	0.31
s w	0.41	0.31	0.22	0.12	0.02	n w	0.08	0.19	0.30	0.40	0.47
sw by w	1.01	0.47	0.32	0.18	0.03	nwb w	0.13	0.29	0.46	1.01	1.13
w s w	1.33	1.12	0.51	0.28	0.05	w n w	0.21	0.49	1.21	1.52	2.22
w by s	2.41	2.08	1.33	0.54	0.10	w by n	0.48				
West	5 16	4.31	3.41	2.41	1.05						
☉ fet	6.02	6.05	6.07	6.05	5.11	☉ fet	6.14	6.16	6.19	6.21	6.23
Sun's Ampl.	d m	d m	d m	d m	d m	Sun's Amp.	d m	d m	d m	d m	d m
	2.34	5.08	7.42	10.16	12.49		15.24	17.59	20.33	22.37	24.13

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
North	12	12	12	12	12	12	12	12	12	12	12
s by w	0.10	0.12	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.29
s s w	0.21	0.25	0.29	0.33	0.38	0.42	0.46	0.50	0.55	0.59	1.02
sw by s	0.34	0.41	0.47	0.54	1.00	1.07	1.14	1.21	1.28	1.34	1.39
s w	0.51	1.00	1.10	1.19	1.29	1.39	1.50	2.01	2.12	2.21	2.29
sw by w	1.14	1.28	1.42	1.56	2.11	2.26	2.41	2.58	3.15	3.30	3.42
w s w	1.54	2.15	2.36	2.57	3.20	3.43	4.08	4.37	5.09	5.40	
w by s	3.14	3.47	4.20	4.55	5.34						
West	6.00										
☉ fet	6.00	5.58	5.55	5.53	5.51	5.49	5.46	5.44	5.41	5.39	5.37

## A Sun-Dial for the Latitude of 14 Degrees.

## NORTH DECLINATION.

Deg. Min.	2 d 30m	5 d 30m	7 d 30m	10 d 30m	12 d 30m	Deg. Min.	15 d 30m	17 d 30m	20 d 30m	22 d 30m	23 d 29m
Point	h m	h m	h m	h m	h m	Point	h m	h m	h m	h m	h m
South	12	12	12	12	12	North	12	12	12	12	12
s by w	0.09	0.07	0.05	0.03	0.01	n by w	0.01	0.03	0.05	0.07	0.08
s s w	0.19	0.15	0.11	0.07	0.03	n n w	0.02	0.06	0.10	0.14	0.17
sw by s	0.30	0.24	0.17	0.11	0.04	nw by n	0.03	0.10	0.17	0.23	0.28
s w	0.45	0.35	0.26	0.16	0.06	n w	0.04	0.15	0.26	0.35	0.43
sw by w	1.06	0.52	0.38	0.24	0.09	nw by w	0.06	0.22	0.40	0.54	1.06
w s w	1.41	1.20	0.59	0.38	0.15	w n w	0.10	0.37	1.08	1.38	2.05
w by s	2.52	2.19	1.46	1.10	0.29	w by n	0.22	1.48			
West	3.19	4.38	3.53	3.00	1.49	West					
☉ set	6.02	5.05	6.07	6.10	6.12	☉ set	6.15	6.18	6.21	6.23	6.25
Sun's Ampl.	2.34	5.09	7.44	10.19	12.55	Sun's Amp.	15.28	18.3	20.38	22.43	24.16

## SOUTH DECLINATION

Deg. Min.	0 d 30m	2 d 30m	5 d 30m	7 d 30m	10 d 30m	12 d 30m	15 d 30m	17 d 30m	20 d 30m	22 d 30m	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.11	0.13	0.15	0.17	0.19	0.21	0.23	0.25	0.27	0.29	0.30
s s w	0.23	0.27	0.31	0.35	0.39	0.44	0.48	0.52	0.57	1.01	1.03
sw by s	0.37	0.43	0.50	0.56	1.03	1.10	1.16	1.23	1.31	1.36	1.41
s w	0.54	1.04	1.15	1.23	1.33	1.43	1.53	2.04	2.15	2.24	2.31
sw by w	1.20	1.33	1.47	2.01	2.15	2.30	2.45	3.02	3.19	3.33	3.45
w s w	2.01	2.21	2.42	3.03	3.25	3.48	4.12	4.40	5.11		
w by s	3.22	3.53	4.25	4.59	5.35						
West	6.00										
☉ set	6.00	5.58	5.55	5.53	5.50	5.48	5.45	5.42	5.39	5.37	5.35

## A Sun-Dial for the Latitude of 15 Degrees.

## NORTH DECLINATION.

Deg. Min.	2 d 30m	5 d 30m	7 d 30m	10 d 30m	12 d 30m	Deg. Min.	15 d 30m	17 d 30m	20 d 30m	22 d 30m	23 d 29m
Point	h m	h m	h m	h m	h m	Point	h m	h m	h m	h m	h m
South	12	12	12	12	12	North	12	12	12	12	12
s by w	0.10	0.08	0.06	0.04	0.02	n by w	Zen. West.	0.02	0.04	0.06	0.07
s s w	0.21	0.16	0.12	0.08	0.04	n n w		0.04	0.09	0.12	0.15
sw by s	0.33	0.26	0.20	0.13	0.07	nw by n		0.17	0.14	0.20	0.25
s w	0.49	0.39	0.30	0.20	0.10	n w		0.11	0.22	0.31	0.38
sw by w	1.11	0.58	0.44	0.30	0.15	nw by w		0.16	0.33	0.47	0.59
w s w	1.48	1.28	1.08	0.47	0.24	w n w	Zen. West.	0.26	0.56	1.24	3.50
w by s	3.00	2.30	1.58	1.24	0.46	w by n		1.06			
West	5.22	4.44	4.02	3.15	2.17						
☉ fet	6.02	6.05	6.08	6.11	6.13	☉ fet	6.16	6.19	6.22	6.25	6.27
Sun's Amp.	d m	d m	d m	d m	d m	Sun's Amp.	d m	d m	d m	d m	d m
	2.35	5.10	7.46	10.21	12.56		15.32	18.8	20.44	22.49	24.24

## SOUTH DECLINATION.

Deg. Min.	0 d 30m	2 d 30m	5 d 30m	7 d 30m	10 d 30m	12 d 30m	15 d 30m	17 d 30m	20 d 30m	22 d 30m	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.12	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.30	0.31
s s w	0.24	0.28	0.32	0.36	0.40	0.45	0.49	0.53	0.58	1.02	1.04
sw by s	0.39	0.46	0.52	0.59	1.05	1.12	1.18	1.25	1.33	1.39	1.43
s w	0.58	1.07	1.17	1.26	1.36	1.46	1.56	2.07	2.18	2.27	2.34
sw by w	1.25	1.38	1.52	2.06	2.20	2.34	2.49	3.05	3.22	3.37	3.48
w s w	2.08	2.28	2.48	3.08	3.29	3.52	4.16	4.42	5.12		
w by s	3.30	4.00	4.30	5.02	5.36						
West	6.00										
☉ fet	6.00	5.58	5.55	5.52	5.49	5.47	5.44	5.41	5.38	5.35	5.33

## A Sun-Dial for the Latitude of 16 Degrees.

## NORTH DECLINATION.

Deg. Min.	2 d 30m	5 d 30m	7 d 30m	10 d 30m	12 d 30m	15 d 30m	Deg. Min.	17 d 30m	20 d 30m	22 d 30m	23 d 29m
Point	h m	h m	h m	h m	h m	h m	Point	h m	h m	h m	h m
South	12	12	12	12	12	12	North	12	12	12	12
s by w	0.11	0.09	0.07	0.05	0.03	0.01	n by w	0.01	0.03	0.05	0.07
s s w	0.22	0.18	0.14	0.10	0.06	0.02	n n w	0.03	0.07	0.11	0.14
sw by s	0.35	0.29	0.23	0.16	0.10	0.03	nw b n	0.04	0.11	0.17	0.22
s w	0.52	0.43	0.34	0.24	0.14	0.04	n w	0.06	0.17	0.26	0.33
sw by w	1.16	1.03	0.49	0.35	0.21	0.06	nwb w	0.10	0.26	0.40	0.52
w by w	2.55	1.36	1.10	0.55	0.33	0.10	w n w	0.16	0.44	1.11	1.34
w by s	3.08	2.39	2.09	1.37	1.02	0.20	w by n	0.36			
West	5.25	4.49	4.11	3.28	2.37	1.23					
☉ fet	6.03	6.06	6.09	6.12	6.15	6.18	☉ fet	6.21	6.24	6.27	6.29
Sun's Ampl.	d m	d m	d m	d m	d m	d m	Sum's Ampl.	d m	d m	d m	d m
	2.36	5.12	7.48	10.24	13.0	15.37		18.13	23.51	22.56	24.31

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d 30m	5 d 30m	7 d 30m	10 d 30m	12 d 30m	15 d 30m	17 d 30m	20 d 30m	22 d 30m	23 d 29m
Point	h m	h m	h m	h m	h m	m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.30	0.33
s s w	0.26	0.30	0.34	0.38	0.42	0.46	0.50	0.55	0.59	1.03	1.06
sw by s	0.42	0.48	0.54	1.01	1.07	1.14	1.21	1.28	1.35	1.41	1.45
s w	1.02	1.11	1.20	1.29	1.39	1.49	1.59	2.10	2.21	2.30	2.37
sw by w	1.30	1.43	1.56	2.10	2.24	2.38	2.53	3.09	3.25	3.40	3.51
w s w	2.15	2.34	2.54	3.14	3.34	3.56	4.19	4.45	5.13		
w by s	3.37	4.05	4.34	5.04	5.36						
West	6.00										
☉ fet	6.00	5.57	5.54	5.51	5.48	5.45	5.42	5.39	5.36	5.33	5.31

## A Sun-Dial for the Latitude of 17 Degrees:

## NORTH DECLINATION.

Deg. Min.	2 d 30m	5 d	7 d 30m	10 d	12 d 30m	15 d	Deg. Min.	17 d 30m	20 d	22 d	23 d 29m
Point	h m	h m	h m	h m	h m	h m	Point	h m	h m	h m	h m
South	12	12	12	12	12	12	North	12	12	12	12
s by w	0.11	0.09	0.07	0.06	0.04	0.02	n by w	0.00	0.02	0.04	0.06
s s w s	0.24	0.20	0.16	0.12	0.08	0.03	n n w	0.01	0.05	0.09	0.12
sw by s	0.38	0.32	0.25	0.19	0.13	0.06	nw by n	0.01	0.08	0.15	0.19
s w	0.56	0.47	0.38	0.28	0.18	0.08	n w	0.02	0.13	0.22	0.29
sw by w	1.21	1.08	0.55	0.41	0.27	0.12	nw by w	0.03	0.19	0.33	0.45
w s w	2.02	1.43	1.23	1.03	0.42	0.19	w n w	0.05	0.33	0.58	1.20
w by s	3.16	2.48	2.20	1.45	1.16	0.37	w by n	0.11	1.36		
West	5.27	4.53	4.18	3.39	2.54	1.55					
w by n					5.50	5.11					
☉ fet	6.03	6.06	6.09	6.12	6.15	6.19	☉ fet	6.22	6.25	6.28	6.31
Sun's Ampl.	d m 2.36	d m 5.13	d m 7.50	d m 10.28	d m 13.04	d m 15.42	Sun's Ampl.	d m 18.19	d m 20.57	d m 24.4	d m 24.40

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d 30m	5 d	7 d 30m	10 d	12 d 30m	15 d	17 d 30m	20 d	22 d	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.13	0.15	0.17	0.19	0.21	0.23	0.25	0.27	0.29	0.31	0.33
s s w	0.28	0.32	0.36	0.39	0.43	0.47	0.51	0.56	1.01	1.04	1.07
sw by s	0.44	0.50	0.57	1.03	1.09	1.16	1.23	1.30	1.37	1.44	1.47
s w	1.05	1.14	1.24	1.33	1.42	1.51	2.02	2.13	2.23	2.32	2.39
sw by w	1.35	1.48	2.01	2.14	2.28	2.42	2.57	3.12	3.29	3.42	3.54
w s w	2.21	2.40	2.59	3.18	3.39	4.00	4.22	4.47	5.14		
w by s	3.43	4.10	4.38	5.07	5.37						
West	6.00										
☉ fet	6.00	5.57	5.54	5.51	5.48	5.45	5.34	5.38	5.35	5.32	5.25

## A Sun-Dial for the Latitude of 18 Degrees.

## NORTH DECLINATION.

Deg. Min.	2 d 30m	5 d	7 d 30m	10 d	12 d 30m	15 d	17 d 30m	Deg. Min.	20 d	22 d	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	Point	h m	h m	h m
South	12	12	12	12	12	12	12	North	12	12	12
s by w	0.12	0.10	0.08	0.06	0.04	0.02	0.00	n by w	0.02	0.03	0.05
s s w	0.25	0.21	0.17	0.13	0.09	0.05	0.01	n n w	0.04	0.07	0.10
sw by s	0.40	0.34	0.28	0.21	0.15	0.09	0.01	nw b n	0.06	0.12	0.16
s w	1.00	0.50	0.41	0.32	0.22	0.12	0.02	n w	0.09	0.17	0.24
sw by w	1.26	1.13	1.00	0.47	0.32	0.18	0.03	nwb w	0.13	0.27	0.38
w by w	2.08	1.50	1.31	1.11	0.51	0.29	0.05	w n w	0.21	0.45	1.06
w by s	3.23	2.57	2.29	2.00	1.29	0.53	0.10	w by n	0.53		
West	5.29	4.57	4.24	3.49	3.08	2.18	0.56	West			
w by n					5.51	5.15	4.32				
☉ fet	6.03	6.06	6.09	6.13	6.16	6.20	6.23	☉ fet	6.27	6.30	6.33
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	Sun's Ampl.	d m	d m	d m
	2.37	5.15	7.53	10.31	13.9	15.47	18.26		21.4	23.12	24.49

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d 30m	5 d	7 d 30m	10 d	12 d 30m	15 d	17 d 30m	20 d	22 d	23 d 29m
Point	h m	h m	h m	h m	h m	m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.30	0.32	0.33
s s w	0.29	0.33	0.37	0.41	0.45	0.49	0.53	0.58	1.02	1.06	1.08
sw by s	0.47	0.53	0.59	1.05	1.12	1.18	1.25	1.32	1.39	1.45	1.49
s w	1.09	1.18	1.27	1.36	1.46	1.55	2.05	2.15	2.26	2.35	2.42
sw by w	1.39	1.52	2.05	2.18	2.32	2.45	3.00	3.15	3.31	3.45	3.56
w s w	2.17	2.45	3.04	3.23	3.43	4.03	4.25	4.49	5.15		
w by s	3.49	4.15	4.41	5.09	5.38						
West	6.00										
☉ fet	6.00	5.57	5.54	5.51	5.47	5.44	5.40	5.37	5.33	5.30	5.27



## A Sun-Dial for the Latitude of 19 Degrees.

## NORTH DECLINATION.

Deg. Min.	2 d 30m	5 d 30m	7 d 30m	10 d 30m	12 d 30m	15 d 30m	17 d 30m	Deg. Min.	20 d 30m	22 d 30m	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	Point	h m	h m	h m
South	12	12	12	12	12	22	12	North	12	12	12
s by w	0.13	0.11	0.09	0.07	0.05	0.03	0.01	n by w	0.01	0.03	0.04
s s w	0.27	0.23	0.19	0.15	0.11	0.07	0.03	n n w	0.02	0.05	0.08
sw by s	0.43	0.37	0.30	0.24	0.18	0.11	0.05	nwybn	0.03	0.09	0.13
s w	1.03	0.54	0.45	0.36	0.26	0.17	0.07	n w	0.04	0.13	0.20
sw byw	1.31	1.18	1.05	0.52	0.38	0.24	0.09	nwybw	0.06	0.20	0.31
w s w	2.15	1.57	1.38	1.19	0.59	0.37	0.15	w n w	0.10	0.33	0.53
w by s	3.30	3.04	2.38	2.11	1.41	1.08	0.29	w by n	0.23		
West	5.31	5.01	4.30	3.57	3.20	2.36	1.35				
w by n					5.52	5.19	4.40				
☉ fet	6.03	6.07	6.10	6.14	6.17	6.21	6.25	☉ fet	6.28	6.31	6.34
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	Sun's Amp	d m	d m	d m
	2.38	5.17	7.56	10.35	13.14	15.53	18.33		21.12	23.20	24.58

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d 30m	5 d 30m	7 d 30m	10 d 30m	12 d 30m	15 d 30m	17 d 30m	20 d 30m	29 d 30m	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.15	0.17	0.19	0.21	0.23	0.25	0.27	0.29	0.30	0.32	0.34
s s w	0.31	0.35	0.38	0.42	0.46	0.50	0.54	0.59	1.03	1.07	1.09
sw by s	0.49	0.55	1.01	1.08	1.14	1.21	1.27	1.34	1.41	1.47	1.51
s w	1.12	1.21	1.30	1.39	1.48	1.58	2.07	2.18	2.29	2.37	2.44
sw by w	1.44	1.57	2.09	2.23	2.36	2.49	3.04	3.19	3.34	3.48	3.58
w s w	2.33	2.51	3.09	3.27	3.46	4.06	4.28	4.51	5.16		
w by s	3.54	4.19	4.44	5.10	5.39						
West	6.00										
☉ fet	6.00	5.57	5.53	5.50	5.46	5.43	5.39	5.35	5.32	5.29	5.26

## A Sun-Dial for the Latitude of 20 Degrees.

## NORTH DECLINATION.

Deg. Min.	2 d 30m	5 d 30m	7 d 30m	10 d 30m	12 d 30m	15 d 30m	17 d 30m	Deg. Min.	20 d	22 d	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	Point	h m	h m	h m
South	12	12	12	12	12	12	12	North	12	12	12
s by w	0.14	0.12	0.10	0.08	0.06	0.04	0.02	n by w	Zen. West.	0.02	0.03
s s w	0.28	0.25	0.21	0.17	0.13	0.09	0.05	n n w		0.04	0.06
w by s	0.45	0.39	0.32	0.26	0.20	0.14	0.07	nw by n		0.06	0.10
s w	1.07	0.58	0.49	0.40	0.30	0.21	0.11	n w		0.09	0.16
sw by w	1.36	1.23	1.10	1.58	0.44	0.30	0.15	nw by w		0.13	0.24
w s w	2.21	2.03	1.45	1.26	1.07	0.46	0.24	w n w		0.22	0.40
w by s	3.36	3.11	2.45	2.20	1.52	1.21	0.45				
West	5.32	5.04	4.35	4.04	3.30	2.50	2.00				
w by n					5.54	5.23	4.47				
☉ fet	6.03	6.07	6.11	6.15	6.18	6.22	6.26	☉ fet	6.30	6.33	6.36
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	Sun's Amp.	d m	d m	d m
	2.40	5.19	7.59	10.39	13.19	16.0	18.40		21.20	23.29	25.8

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d 30m	5 d 30m	7 d 30m	10 d 30m	12 d 30m	15 d 30m	17 d 30m	20 d	22 d	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.16	0.17	0.19	0.21	0.23	0.25	0.27	0.29	0.31	0.33	0.34
s s w	0.32	0.36	0.40	0.44	0.48	0.52	0.56	1.00	1.05	1.08	1.11
sw by s	0.51	0.58	1.04	1.10	1.16	1.23	1.29	1.36	1.43	1.49	1.53
s w	1.16	1.24	1.33	1.42	1.51	2.01	2.10	2.20	2.31	2.40	2.47
sw by w	1.48	2.01	2.14	2.26	2.39	2.53	3.07	3.22	3.37	3.50	4.00
w s w	2.38	2.56	3.13	3.31	3.50	4.09	4.30	4.52	5.16		
w by s	3.59	4.23	4.47	5.12	5.39						
West	6.00										
☉ fet	6.00	5.57	5.53	5.49	5.45	5.42	5.38	5.34	5.30	5.27	5.24

## A Sun-Dial for the Latitude of 21 Degrees.

## NORTH DECLINATION.

Deg. Min	2 d 30m	5 d	7 d 30m	10 d	12 d 30m	15 d	17 d 30m	20 d	Deg. Min.	22 d	23 d 30m
Point	h m	h m	h m	h m	h m	h m	h m	h m	Point	h m	h m
South	12	12	12	12	12	22	12	12	North	12	12
s by w	0.14	0.13	0.11	0.09	0.07	0.05	0.03	0.01	n by w	0.01	0.02
s s w	0.30	0.26	0.22	0.18	0.14	0.10	0.06	0.02	n n w	0.02	0.04
sw by s	0.48	0.42	0.35	0.29	0.23	0.16	0.10	0.03	nwybn	0.03	0.07
s w	1.10	1.01	0.52	0.43	0.34	0.24	0.15	0.04	n w	0.04	0.11
sw byw	1.40	1.28	1.15	1.03	0.49	0.36	0.21	0.06	nwybw	0.06	0.17
w s w	2.36	2.09	1.52	1.34	1.15	0.55	0.33	0.10	w n w	0.11	0.28
w by s	3.41	3.18	2.54	2.29	2.03	1.33	1.00	0.20	w by n	0.24	
West	5.34	5.07	4.40	4.11	3.39	3.03	2.19	1.14			
w by n					5.55	5.26	4.53	4.12			
☉ fet	6.04	6.08	6.12	6.16	6.20	6.24	6.28	6.32	☉ fet	6.35	6.38
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	Sun's Amp	d m	d m
	2.41	5.21	8.02	10.43	13.24	16.6	18.47	21.29		23.39	25.28

## SOUTH DECLINATION.

Deg. Min.	1 d	2 d 30m	5 d	7 d 30m	10 d	12 d 30m	15 d	17 d 30m	20 d	29 d	23 d 30m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.30	0.32	0.34	0.35
s s w	0.34	0.38	0.42	0.45	0.49	0.54	1.58	1.02	1.06	1.10	1.12
sw by s	0.54	1.00	1.06	1.12	1.19	1.25	1.32	1.38	1.45	1.51	1.55
s w	1.19	1.28	1.37	1.46	1.54	2.04	2.13	2.23	2.33	2.42	2.49
sw by w	1.53	2.05	2.18	2.30	2.41	2.56	3.10	3.24	3.39	3.52	4.02
w s w	2.43	3.01	3.18	3.35	3.54	4.12	4.32	5.53	5.17		
w by s	4.04	4.27	4.50	5.14	5.39						
West	6.00										
☉ fet	6.00	5.56	5.52	5.48	5.44	5.40	5.36	5.32	5.28	5.25	5.22

## A Sun-Dial for the Latitude of 22 Degrees.

## NORTH DECLINATION.

Deg. Min.	2 d 30m	5 d	7 d 30m	10 d	12 d 30m	15 d	17 d 30m	20 d	Deg. Min.	22 d	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	Point	h m	h m
South	12	12	12	12	12	12	12	12	North	12	12
s by w	0.15	0.13	0.11	0.09	0.08	0.06	0.04	0.02	n by w	Zen. West.	0.01
s s w	0.31	0.28	0.24	0.20	0.16	0.12	0.08	0.04	n n w		0.03
sw by s	0.50	0.44	0.38	0.32	0.25	0.19	0.13	0.06	nw by n		0.04
s w	1.14	1.05	0.56	0.47	0.38	0.29	0.19	0.08	n w		0.07
sw by w	1.45	1.33	1.20	1.08	0.55	0.41	0.27	0.13	nw by w		0.10
w s w	2.32	2.15	1.58	1.40	1.22	1.03	0.42	0.20	w n w		0.17
w by s	3.46	3.24	3.01	2.38	2.12	1.45	1.14	0.37			
West	5.35	5.10	4.44	4.17	3.47	3.14	2.35	1.43			
w by n					5.56	5.28	4.58	4.21			
☉ set	6.04	6.08	6.12	6.16	6.21	6.25	6.29	6.34	☉ set	6.37	6.40
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	Sun's Amp.	d m	d m
	2.42	5.23	8 05	10.48	13.30	16.13	18.55	21.39		23.50	25.20

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d 30m	5 d	7 d 30m	10 d	12 d 30m	15 d	17 d 30m	20 d	22 d	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.17	0.19	0.21	0.23	0.25	0.27	0.28	0.30	0.32	0.34	0.35
s s w	0.35	0.39	0.43	0.47	0.50	0.55	0.59	1.03	1.07	1.11	1.13
sw by s	0.56	1.02	1.08	1.14	1.21	1.27	1.33	1.40	1.47	1.52	1.57
s w	1.22	1.31	1.40	1.49	1.58	2.07	2.16	2.25	2.36	2.44	2.51
sw by w	1.57	2.09	2.21	2.34	2.46	2.59	3.13	3.27	3.42	3.54	4.04
w s w	2.40	3.00	3.22	3.39	3.57	4.15	4.34	4.55	5.17		
w by s	4.08	4.30	4.52	5.15	5.39						
West	6.00										
☉ set	6.00	5.56	5.52	5.48	5.44	5.39	5.35	5.31	5.26	5.23	5.20

## A Sun-Dial for the Latitude of 23 Degrees.

## NORTH DECLINATION.

Deg. Min.	2 d 30m	5 d	7 d 30m	10 d	12 d 30m	15 d	17 d 30m	20 d	22 d	Deg. Min.	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	Point	h m
South	12	12	12	12	12	12	12	12	12	North	12
s by w	0.16	0.14	0.12	0.11	0.09	0.07	0.05	0.03	0.01	n by w	0.00
s s w s	0.33	0.30	0.26	0.22	0.18	0.14	0.10	0.05	0.02	n n w	0.01
sw by s	0.53	0.47	0.41	0.34	0.28	0.22	0.16	0.09	0.03	nw by n	0.01
s w	1.17	1.08	1.00	0.50	0.41	0.32	0.23	0.13	0.04	n w	0.02
sw by w	1.49	1.37	1.25	1.13	0.00	0.47	0.33	0.19	0.06	nw by w	0.03
w s w	2.37	2.21	2.04	1.47	1.29	1.11	0.51	0.29	0.10	w n w	0.06
w by s	3.51	3.30	3.08	2.45	2.21	1.55	1.26	0.54	0.20		
West	5.36	5.12	4.48	4.22	3.54	3.23	2.48	2.04	1.11		
w by n				6.21	5.57	5.31	4.02	4.29	3.56		
☉ fet	6.04	6.09	6.13	6.17	6.22	6.26	6.31	6.36	6.39	☉ fet	6.42
Sun's	d m	d m	d m	d m	d m	d m	d m	d m	d m	Sun's	d m
Ampl.	2.42	5.26	8.10	10.52	13.36	16.20	19.4	21.49	24.1	Amp.	25.41

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d 30m	5 d	7 d 30m	10 d	12 d 30m	15 d	17 d 30m	20 d	22 d	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.18	0.20	0.22	0.24	0.26	0.28	0.29	0.31	0.33	0.35	0.36
s s w	0.37	0.41	0.44	0.48	0.51	0.56	1.00	1.04	1.08	1.12	1.15
sw by s	0.59	1.04	1.10	1.16	1.23	1.29	1.35	1.42	1.49	1.54	1.59
s w	1.25	1.34	1.43	1.51	2.01	2.10	2.19	2.28	2.38	2.46	2.53
sw by w	2.01	2.13	2.25	2.37	2.50	3.02	3.16	3.29	3.44	3.56	4.06
w s w	2.53	3.10	3.26	3.43	4.00	4.17	4.36	4.56	5.17		
w by s	4.12	4.33	4.54	5.16	5.39						
West	6.00										
☉ fet	6.00	5.56	5.51	5.47	5.43	5.38	5.34	5.29	5.24	5.21	5.18

## A Sun-Dial for the Latitude of 24 Degrees.

## NORTH DECLINATION.

Min. Deg.	2 d 30m	5 d 30m	7 d 30m	10 d 30m	12 d 30m	15 d 30m	17 d 30m	20 d 30m	22 d 30m	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12
s by w	0.17	0.15	0.13	0.11	0.09	0.08	0.06	0.04	0.02	0.00
s s w	0.35	0.31	0.27	0.23	0.19	0.15	0.11	0.07	0.04	0.01
sw by s	0.55	0.49	0.43	0.37	0.31	0.24	0.18	0.11	0.06	0.01
s w	1.20	1.12	1.03	0.53	0.44	0.35	0.27	0.17	0.09	0.02
sw by w	1.54	1.42	1.30	1.18	1.05	0.52	0.39	0.24	0.13	0.03
w s w	2.42	2.26	2.10	1.53	1.36	1.18	0.59	0.38	0.20	0.05
w by s	3.56	3.35	3.14	2.52	2.29	2.05	1.38	1.07	0.38	0.10
West	5.37	5.15	4.51	4.27	4.01	3.32	3.00	2.21	1.39	0.50
w by n				6.21	5.58	5.33	5.06	4.35	4.06	3.39
									6.24	6.09
☉ fet	6.04	5.09	6.13	6.18	6.23	6.27	6.32	6.37	6.41	6.44
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	2.44	5.28	8.13	10.57	13.42	16.27	19.13	21.59	24.12	25.54

## SOUTH DECLINATION

Deg. Min.	0 d 30m	2 d 30m	5 d 30m	7 d 30m	10 d 30m	12 d 30m	15 d 30m	17 d 30m	20 d 30m	22 d 30m	23 d 29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.18	0.20	0.22	0.24	0.26	0.28	0.29	0.31	0.33	0.35	0.37
s s w	0.38	0.42	0.46	0.50	0.53	0.57	1.01	1.05	1.10	1.13	1.16
sw by s	1.01	1.07	1.13	1.19	1.25	1.31	1.37	1.44	1.50	1.56	2.00
s w	1.29	1.37	1.46	1.54	2.40	2.13	2.21	2.31	2.40	2.48	2.55
sw by w	2.05	2.17	2.29	2.41	2.53	3.05	3.18	3.32	3.46	3.58	4.08
w s w	2.58	3.14	3.30	3.46	4.02	4.20	4.38	4.57	5.18		
w by s	4.16	4.36	4.56	4.17	5.39						
West	6.00										
☉ fet	6.00	5.56	5.51	5.47	5.42	5.37	5.33	5.28	5.23	5.19	5.16

## A Sun-Dial for the Latitude of 25 Degrees

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
			30m	30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.19	0.17	0.16	0.14	0.12	0.10	0.08	0.06	0.04	0.00	0.01
s s w	0.40	0.36	0.32	0.29	0.25	0.21	0.17	0.13	0.09	0.05	0.03
sw by s	1.03	0.57	0.51	0.45	0.39	0.33	0.27	0.21	0.14	0.09	0.04
s w	1.32	1.23	1.15	1.06	0.57	0.49	0.40	0.31	0.21	0.13	0.06
sw by w	2.09	1.58	1.46	1.35	1.22	1.10	0.58	0.44	0.31	0.19	0.10
w s w	3.02	2.47	2.32	2.16	2.00	1.43	1.25	1.07	0.47	0.29	0.15
w by s	4.19	4.00	3.40	3.20	2.59	2.37	2.14	1.48	1.19	0.53	0.29
West	6.00	5.38	4.17	4.54	4.31	4.06	3.40	3.10	2.35	2.00	1.24
w by n					6.21	5.59	5.36	5.10	4.41	4.14	3.50
w n w										6.25	6.10
☉ fet	6.00	6.05	6.09	6.14	6.19	6.24	6.29	6.34	6.39	6.43	6.47
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0.00	2.45	5.31	8.16	11.3	13.49	16.35	19.22	22.10	24.24	26.8

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
			30m	30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
North	12	12	12	12	12	12	12	12	12	12	12
s by w	0.19	0.21	0.23	0.25	0.27	0.28	0.30	0.32	0.34	0.36	0.37
s s w	0.40	0.43	0.47	0.51	0.55	0.59	1.02	1.06	1.10	1.14	1.17
sw by s	1.03	1.09	1.15	1.21	1.27	1.33	1.39	1.46	1.52	1.58	2.02
s w	1.32	1.40	1.48	1.57	2.06	2.15	2.23	2.33	2.42	2.50	2.57
sw by w	2.09	2.21	2.33	2.44	2.56	3.08	3.21	3.34	3.48	4.00	4.09
w s w	3.02	3.18	3.33	3.49	4.05	4.22	4.39	4.58	5.19		
w by s	4.19	4.39	4.58	5.18	5.39						
West	6.00										
☉ fet	5.00	5.55	5.51	5.46	5.41	5.36	5.31	5.26	5.21	5.17	5.17

## A Sun-Dial for the Latitude of 26 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.20	0.18	0.16	0.14	0.13	0.11	0.09	0.07	0.05	0.03	0.02
s s w	0.41	0.38	0.34	0.30	0.26	0.21	0.15	0.15	0.11	0.07	0.04
sw by s	1.05	0.59	0.54	0.48	0.42	0.36	0.30	0.24	0.17	0.11	0.07
s w	1.35	1.26	1.18	1.10	1.01	0.52	0.43	0.34	0.25	0.17	0.11
sw by w	2.13	2.02	1.50	1.39	1.27	1.15	1.03	0.50	0.36	0.25	0.16
w s w	3.07	3.52	2.37	2.21	2.06	1.49	1.32	1.14	0.55	0.38	0.25
w by s	4.22	4.04	3.45	3.25	3.06	2.46	3.23	1.58	1.31	1.07	0.45
West	6.00	5.39	5.19	4.57	4.35	4.12	3.47	3.15	2.47	2.16	1.47
w by n					6.21	6.00	5.38	5.13	4.40	4.22	4.00
w n w									6.42	6.25	6.12
☉ fet	6.00	6.05	6.10	6.15	6.20	6.25	6.30	6.35	6.41	6.45	6.49
Sun's Ampl.	0.00	2.46	5.33	8.21	11.8	13.56	16.44	19.33	22.21	24.37	26.23

## SOUTH DECLINATION

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.20	0.22	0.24	0.25	0.27	0.29	0.31	0.33	0.35	0.36	0.38
s s w	0.41	0.45	0.49	0.52	0.56	1.00	1.04	1.08	1.12	1.15	1.18
sw by s	1.05	1.11	1.17	1.23	1.29	1.35	1.41	1.47	1.54	1.59	2.03
s w	1.35	1.43	1.51	2.0	2.08	2.17	2.26	2.25	2.44	2.52	2.59
sw by w	2.13	2.24	2.36	2.47	2.59	3.11	3.23	3.36	3.50	4.01	4.10
w s w	3.07	3.21	3.37	3.52	4.08	4.24	4.40	4.59	5.18		
w by s	4.22	4.41	5.00	5.19	5.39						
West	6.00										
☉ fet	6.00	5.55	5.50	5.45	5.40	5.35	5.30	5.25	5.19	5.15	5.11





## A Sun-Dial for the Latitude of 27 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	22	12	12	12	12
s by w	0.21	0.19	0.17	0.15	0.13	0.12	0.11	0.08	0.06	0.04	0.03
s s w	0.43	0.39	0.35	0.32	0.28	0.24	0.20	0.17	0.12	0.09	0.06
sw by s	1.07	1.02	0.56	0.50	1.45	0.39	0.33	0.27	0.20	0.13	0.10
s w	1.38	1.30	1.21	1.13	1.05	0.55	0.47	0.38	0.29	0.21	0.15
sw by w	2.17	2.06	1.55	1.43	1.32	1.20	1.08	0.55	0.42	0.32	0.23
w s w	3.10	2.56	2.41	2.26	2.11	1.55	1.39	1.22	1.03	0.47	0.34
w by s	4.25	4.07	3.49	3.31	3.11	2.51	2.31	2.07	1.42	1.19	0.59
West	6.00	5.40	5.21	5.00	4.39	4.17	3.53	3.27	2.58	2.30	2.05
w by n					6.21	6.01	5.39	5.17	4.51	4.28	4.09
w n w									5.42	6.26	6.13
☉ set	6.00	6.05	6.10	6.15	6.21	6.26	6.31	6.37	6.43	6.46	6.51
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0.00	2.48	5.37	8.25	11.14	14.03	16.53	19.43	22.54	24.51	26.37

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.21	0.22	0.24	0.26	0.28	0.30	0.32	0.34	0.37	0.37	0.38
s s w	0.43	0.46	0.50	0.53	0.57	1.01	1.07	1.09	1.13	1.16	1.19
sw by s	1.07	1.13	1.19	1.25	1.30	1.36	1.42	1.48	1.55	2.01	2.05
s w	1.38	1.46	1.54	2.02	2.11	2.19	2.28	2.37	2.46	2.54	3.00
w by w	2.17	2.28	2.39	2.50	3.02	3.13	3.26	3.38	3.52	4.02	4.10
w s w	3.10	3.25	3.40	3.54	4.10	4.25	4.42	4.59	5.18		
w by s	4.25	4.43	5.02	5.20	5.39						
West	6.00										
☉ set	6.00	5.55	5.50	5.45	5.39	5.34	5.29	5.23	5.17	5.12	5.09

## A Sun-Dial for the Latitude of 12 Degrees.

## NORTH DECLINATION.

Deg. Min	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.21	0.20	0.18	0.16	0.14	0.13	0.11	0.09	0.07	0.05	0.04
s s w	0.44	0.40	0.37	0.33	0.30	0.26	0.22	0.18	0.14	0.11	0.08
sw by s	1.10	1.04	0.58	0.53	0.47	0.41	0.35	0.29	0.22	0.16	0.13
s w	1.41	1.33	1.25	1.17	1.08	1.00	0.51	0.42	0.33	0.25	0.19
sw by w	2.20	2.10	1.59	1.48	1.36	1.25	1.13	1.01	0.48	0.37	0.28
w s w	3.14	3.00	2.46	2.31	2.17	2.01	1.45	1.28	1.11	0.55	0.43
w by s	4.28	4.11	3.53	3.36	3.17	2.58	2.38	2.16	1.52	1.31	1.13
West	6.00	5.41	5.22	5.03	4.43	4.21	3.59	3.35	3.07	2.42	2.20
w by n					6.21	6.02	5.41	5.20	4.54	4.34	4.16
w n w									6.42	6.27	6.14
☉ fet	6.00	6.05	6.11	6.16	6.22	6.27	6.33	6.39	6.45	6.50	6.53
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0.00	2.50	5.40	8.30	11.21	14.11	17.3	20.51	23.48	25.6	26.52

## SOUTH DECLINATION

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.21	0.23	0.25	0.27	0.28	0.30	0.32	0.34	0.36	0.38	0.39
s s w	0.44	0.48	0.51	0.55	0.58	1.02	1.06	1.10	1.14	1.17	1.20
sw by s	1.10	1.15	1.21	1.27	1.32	1.38	1.44	1.51	1.57	2.03	2.06
s w	1.41	1.49	1.57	2.05	2.13	2.21	2.30	2.39	2.47	2.56	3.02
sw by w	2.20	2.31	2.42	2.53	3.04	3.16	3.28	3.40	3.53	4.04	4.13
w s w	3.14	3.28	3.43	3.57	4.12	4.27	4.44	5.00	5.18		
w by s	4.28	4.45	5.03	5.21	5.39						
West	6.00										
☉ fet	6.00	5.55	5.49	5.44	5.38	5.33	5.27	5.21	5.15	5.10	5.07

## A Sun-Dial for the Latitude of 29 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.22	0.20	0.19	0.17	0.15	0.13	0.11	0.10	0.08	0.06	0.05
s s w s	0.45	0.42	0.38	0.35	0.31	0.27	0.23	0.19	0.16	0.12	0.10
sw by s	1.12	1.06	1.01	0.55	0.49	0.43	0.37	0.31	0.25	0.20	0.16
s w	1.43	1.36	1.28	1.20	1.12	1.03	0.55	0.46	0.37	0.29	0.23
sw by w	2.23	2.13	2.03	1.52	1.41	1.30	1.18	1.06	0.53	0.42	0.34
w s w	3.18	3.04	2.50	2.36	2.22	2.07	1.52	1.35	1.18	1.03	0.51
w by s	4.31	4.14	3.57	3.40	3.22	3.05	2.45	2.24	2.01	1.41	1.24
West	6.00	5.42	5.24	5.05	4.46	4.26	4.04	3.41	3.16	2.53	2.33
w by n					6.21	6.02	5.43	5.22	5.00	4.40	4.23
w n w									6.40	6.27	6.15
☉ fet	6.00	6.06	6.11	6.17	6.23	6.28	6.34	6.40	6.47	6.52	6.55
Sun's Ampl	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	2.00	2.51	5.43	8.35	11.27	14.19	17.12	20.6	23.2	25.22	27.8

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.22	0.24	0.26	0.27	0.29	0.31	0.33	0.35	0.37	0.38	0.39
s s w	0.45	0.49	0.53	0.56	1.00	1.04	1.08	1.11	1.15	1.18	1.21
sw by s	1.12	1.17	1.23	1.29	1.34	1.4	1.46	1.52	1.59	2.04	2.08
s w	1.43	1.51	1.56	2.07	2.15	2.24	2.32	2.41	2.49	2.58	3.04
sw by w	2.23	2.34	2.45	2.56	3.07	3.18	3.30	3.42	3.55	4.05	4.14
w s w	3.18	3.32	3.46	4.00	4.14	4.29	4.44	5.00			
w by s	4.31	4.48	5.04	5.22	5.39						
West	6.00										
☉ fet	6.00	5.54	5.49	5.43	5.37	5.32	5.26	5.20	5.13	5.08	5.05

## A Sun-Dial for the Latitude of 30 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.23	0.21	0.19	0.18	0.16	0.14	0.12	0.10	0.08	0.07	0.06
s s w	0.47	0.43	0.40	0.36	0.33	0.29	0.25	0.21	0.17	0.14	0.12
sw by s	1.14	1.08	1.03	0.58	0.52	0.46	0.40	0.34	0.28	0.23	0.19
s w	1.46	1.38	1.31	1.23	1.15	1.07	0.58	0.50	0.41	0.33	0.27
sw by w	2.27	2.17	2.06	1.50	1.45	1.34	1.23	1.11	0.58	0.48	0.40
w by w	3.21	3.08	2.55	2.4	2.27	2.13	1.58	1.42	1.25	1.11	0.59
w by s	4.33	4.17	4.01	3.44	3.27	3.10	2.51	2.31	2.10	1.51	1.35
West	6.00	5.43	5.25	5.07	4.49	4.30	4.09	3.48	3.24	3.02	2.44
w by n					6.21	5.03	5.45	5.25	5.03	4.45	4.29
w n w									6.42	5.28	6.17
☉ fet	6.00	6.06	6.12	6.18	6.2	6.29	6.37	6.42	5.48	5.54	6.58
Sun's Ampl.	0.00	2.53	5.46	3.4	11.34	14.28	17.23	20.18	23.16	25.38	27.25

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.23	0.21	0.26	0.28	0.30	0.31	0.33	0.35	0.37	0.39	0.40
s s w	0.47	0.50	0.54	1.57	1.01	1.05	1.09	1.12	1.16	1.19	1.22
sw by s	1.14	1.11	1.25	1.30	1.36	1.42	1.48	1.54	2.00	2.05	2.09
s w	1.46	1.54	2.02	2.10	2.18	2.26	2.34	2.43	2.50	2.55	3.05
sw by w	2.27	2.38	2.48	2.58	3.09	3.20	3.32	3.44	3.56	4.06	4.14
w s w	3.21	3.30	3.48	4.02	4.16	4.30	4.45	5.01			
w by s	4.33	4.49	5.05	5.22	5.39						
West	6.00										
fet	5.01	5.54	5.48	5.42	5.37	5.31	5.24	5.18	5.12	5.06	5.02

A Sun-Dial for the Latitude of 31 Degrees.

NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.23	0.22	0.20	0.18	0.17	0.15	0.13	0.11	0.09	0.08	0.07
s s w	0.48	0.45	0.41	0.38	0.34	0.31	0.27	0.23	0.19	0.16	0.13
sw by s	1.16	1.11	1.05	1.00	0.94	0.48	0.43	0.37	0.31	0.25	0.21
s w	1.49	1.41	1.34	1.26	1.18	1.10	1.02	0.53	0.45	0.37	0.32
sw by w	2.30	2.20	2.10	2.00	1.49	1.38	1.27	1.16	1.04	0.54	0.46
w s w	3.25	3.12	2.59	2.46	2.32	2.18	2.03	1.48	1.32	1.18	1.07
w by s	4.36	4.20	4.04	3.48	3.32	3.15	2.57	2.38	2.18	2.00	1.46
West	6.00	5.43	5.26	5.09	4.52	4.33	4.14	3.53	3.31	3.11	2.55
w by n					6.21	5.04	5.46	5.27	5.07	4.49	4.35
w n w									6.43	6.29	6.18
☉ fet	6.00	6.06	6.12	6.18	6.24	6.31	6.37	6.44	6.51	6.56	7.01
Sun's Amp.	0.00	2.55	5.50	8.46	11.41	14.37	17.34	20.31	23.31	25.55	27.43

SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.23	0.25	0.27	0.28	0.30	0.32	0.34	0.36	0.38	0.39	0.40
s s w	0.48	0.52	0.55	0.59	1.02	1.06	1.10	1.13	1.17	1.20	1.23
sw by s	1.16	1.21	1.27	1.32	1.38	1.44	1.49	1.54	2.01	2.07	2.11
s w	1.49	1.57	2.04	2.12	2.20	2.28	2.36	2.45	2.52	3.01	3.06
sw by w	2.30	2.41	2.51	3.01	3.12	3.23	3.34	3.45	3.57	4.07	4.15
w s w	3.25	3.38	3.51	4.04	4.18	4.32	4.46	5.01			
w by s	4.36	4.50	5.07	5.23							
West	6.00										
☉ fet	6.00	5.54	5.48	5.42	5.36	5.29	5.23	5.16	5.09	5.04	4.59

## A Sun-Dial for the Latitude of 32 Degrees.

## NORTH DECLINATION.

Min. Deg.	1 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.24	0.22	0.21	0.19	0.17	0.16	0.14	0.12	0.10	0.09	0.07
s s w	0.50	0.46	0.43	0.39	0.36	0.32	0.29	0.25	0.21	0.18	0.15
sw by s	1.18	1.13	1.07	1.02	0.96	0.91	0.85	0.79	0.73	0.68	0.62
s w	1.52	1.44	1.37	1.29	1.22	1.14	1.05	0.97	0.89	0.81	0.73
sw by w	2.34	2.24	2.14	2.04	1.94	1.83	1.72	1.61	1.50	1.39	1.28
w s w	3.28	3.15	3.03	2.50	2.37	2.23	2.09	1.94	1.79	1.65	1.50
w by s	4.38	4.23	4.08	3.52	3.37	3.20	3.03	2.85	2.66	2.47	2.28
West	6.00	5.44	5.28	5.11	4.55	4.37	4.19	3.99	3.78	3.57	3.36
why n					6.21	6.05	5.48	5.30	5.10	4.53	4.39
w n w									6.43	6.30	6.19
☉ fet	5.00	6.06	6.13	6.19	6.25	6.32	6.39	6.46	6.53	6.58	7.03
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	6.00	2.57	5.54	8.51	11.48	14.47	17.46	20.45	23.47	16.13	28.3

## SOUTH DECLINATION

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.24	0.26	0.27	0.29	0.31	0.32	0.34	0.36	0.38	0.40	0.41
s s w	0.50	0.53	0.56	1.00	1.03	1.07	1.11	1.14	1.18	1.21	1.24
sw by s	1.18	1.23	1.29	1.34	1.40	1.45	1.50	1.57	2.03	2.08	2.12
s w	1.52	1.59	2.07	2.14	2.22	2.30	2.38	2.47	2.55	3.02	3.08
sw by w	2.34	2.44	2.54	3.04	3.14	3.25	3.35	3.47	3.59	4.08	4.16
w s w	3.28	3.41	3.53	4.06	4.19	4.33	4.47	5.02			
w by s	4.38	4.53	5.08	5.23							
West	6.00										
☉ fet	5.00	5.54	5.47	5.41	5.35	5.28	5.21	5.14	5.07	5.02	4.57

## A Sun-Dial for the Latitude of 33 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.25	0.23	0.21	0.20	0.18	0.16	0.15	0.13	0.11	0.09	0.08
s s w	0.51	0.47	0.44	0.41	0.37	0.34	0.30	0.27	0.23	0.19	0.17
sw by s	1.20	1.15	1.09	1.04	0.99	0.93	0.88	0.82	0.76	0.71	0.67
s w	1.54	1.47	1.40	1.32	1.25	1.17	1.09	1.01	0.93	0.86	0.80
sw by w	2.37	2.27	2.17	2.07	1.97	1.87	1.76	1.65	1.54	1.44	1.34
w s w	3.31	3.19	3.06	2.54	2.41	2.28	2.14	2.00	1.85	1.72	1.59
w by s	4.40	4.25	4.11	3.56	3.41	3.25	3.09	2.51	2.33	2.17	2.04
West	6.00	5.45	5.29	5.13	4.57	4.40	4.23	4.04	3.44	3.26	3.12
w by n					6.21	6.05	5.49	5.32	5.13	4.57	4.44
w n w									6.43	6.30	6.20
☉ set	6.00	6.07	6.13	6.20	6.26	6.33	6.40	6.47	6.55	7.01	7.06
Sun's Amp.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0.00	2.59	5.57	8.57	11.55	14.57	17.58	21.0	24.4	26.32	28.23

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.23	0.26	0.28	0.30	0.31	0.33	0.35	0.37	0.39	0.40	0.41
s s w	0.51	0.54	0.58	0.61	1.05	1.08	1.12	1.15	1.19	1.22	1.25
sw by s	1.20	1.25	1.30	1.36	1.41	1.47	1.52	1.58	2.04	2.09	2.13
s w	1.54	2.02	2.09	2.17	2.24	2.32	2.40	2.48	2.56	3.40	3.10
sw by w	2.37	2.46	2.56	3.06	3.16	3.27	3.37	3.48	4.00	4.09	4.17
w s w	3.31	3.43	3.56	4.08	4.21	4.34	4.48	5.02			
w by s	4.40	4.54	5.09	5.24							
West	6.00										
☉ set	6.00	5.53	5.47	5.40	5.34	5.27	5.20	5.13	5.05	4.59	4.54

## A Sun-Dial for the Latitude of 34 Degrees.

## NORTH DECLINATION.

Min. Deg.	1 d	2 d	3 d	4 d	5 d	6 d	7 d	8 d	9 d	10 d	11 d	12 d	13 d	14 d	15 d	16 d	17 d	18 d	19 d	20 d	21 d	22 d	23 d
Point	m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
s by w	0.25	0.24	0.22	0.20	0.19	0.17	0.15	0.14	0.12	0.10	0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.00	0.00	0.00
s s w	0.52	0.49	0.45	0.42	0.39	0.35	0.32	0.28	0.24	0.21	0.19	0.17	0.15	0.13	0.11	0.09	0.07	0.05	0.03	0.01	0.00	0.00	0.00
sw by s	1.22	1.17	1.12	1.07	1.01	0.96	0.90	0.84	0.78	0.72	0.66	0.60	0.54	0.48	0.42	0.36	0.30	0.24	0.18	0.12	0.06	0.00	0.00
s w	1.57	1.50	1.42	1.35	1.28	1.20	1.12	1.04	0.96	0.88	0.80	0.72	0.64	0.56	0.48	0.40	0.32	0.24	0.16	0.08	0.00	0.00	0.00
sw by w	2.40	2.30	2.21	2.11	2.01	1.91	1.81	1.70	1.60	1.50	1.40	1.30	1.19	1.09	0.98	0.88	0.77	0.66	0.55	0.44	0.33	0.22	0.11
w s w	3.34	3.22	3.10	2.58	2.45	2.33	2.19	2.06	1.91	1.79	1.66	1.53	1.40	1.27	1.14	1.01	0.88	0.75	0.62	0.49	0.36	0.23	0.10
w by s	4.42	4.28	4.14	3.59	3.45	3.30	3.14	2.57	2.40	2.24	2.12	1.99	1.86	1.73	1.59	1.46	1.33	1.19	1.06	0.93	0.79	0.66	0.53
West	6.00	5.45	5.30	5.15	5.00	4.43	4.26	4.09	3.49	2.33	1.19	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
w by n					6.21	6.06	5.50	5.34	5.16	5.01	4.49	4.34	4.18	4.03	3.87	3.71	3.55	3.39	3.23	3.07	2.91	2.75	2.59
w n w									6.43	6.31	6.21	6.10	6.00	5.50	5.40	5.30	5.20	5.10	5.00	4.50	4.40	4.30	4.20
☉ set	5.00	6.07	6.14	6.20	6.27	6.34	6.42	6.49	6.57	7.03	7.08	7.13	7.18	7.23	7.28	7.33	7.38	7.43	7.48	7.53	7.58	7.63	7.68
Sun's Ampl.	0.00	3.01	6.02	9.03	12.05	15.08	18.11	21.16	24.22	27.28	30.35	33.42	36.48	39.55	42.62	45.69	48.76	51.83	54.90	57.97	61.04	64.11	67.18

## SOUTH DECLINATION

Deg. Min.	0 d	1 d	2 d	3 d	4 d	5 d	6 d	7 d	8 d	9 d	10 d	11 d	12 d	13 d	14 d	15 d	16 d	17 d	18 d	19 d	20 d	21 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
s by w	0.25	0.27	0.29	0.30	0.32	0.34	0.35	0.37	0.39	0.41	0.42	0.43	0.44	0.45	0.46	0.47	0.48	0.49	0.50	0.51	0.52	0.53	0.54	0.55
s s w	0.52	0.55	0.59	1.02	1.06	1.09	1.13	1.16	1.20	1.23	1.26	1.29	1.32	1.35	1.38	1.41	1.44	1.47	1.50	1.53	1.56	1.59	1.62	1.65
sw by s	1.22	1.27	1.32	1.38	1.43	1.48	1.54	2.00	2.05	2.10	2.14	2.19	2.24	2.29	2.34	2.39	2.44	2.49	2.54	2.59	2.64	2.69	2.74	2.79
s w	1.57	2.04	2.11	2.19	2.26	2.34	2.42	2.50	2.57	3.05	3.10	3.15	3.20	3.25	3.30	3.35	3.40	3.45	3.50	3.55	3.60	3.65	3.70	3.75
sw by w	2.40	2.49	2.59	3.09	3.18	3.28	3.39	3.50	4.01	4.10	4.18	4.27	4.36	4.45	4.54	5.03	5.12	5.21	5.30	5.39	5.48	5.57	5.66	5.75
w s w	3.34	3.46	3.58	4.10	4.22	4.35	4.48	5.02	5.14	5.27	5.39	5.52	6.04	6.17	6.30	6.43	6.56	7.09	7.22	7.35	7.48	7.61	7.74	7.87
w by s	4.42	4.56	5.10	5.24																				
West	6.00																							
☉ set	5.00	5.53	5.46	5.40	5.33	5.26	5.18	5.11	5.03	4.57	4.52	4.47	4.42	4.37	4.32	4.27	4.22	4.17	4.12	4.07	4.02	3.97	3.92	3.87



## A Sun-Dial for the Latitude of 35 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.26	0.24	0.23	0.21	0.19	0.18	0.16	0.14	0.13	0.11	0.10
s s w	0.53	0.50	0.47	0.44	0.41	0.37	0.33	0.30	0.26	0.23	0.20
sw by s	1.24	1.19	1.14	1.09	1.03	0.58	0.52	0.47	0.41	0.36	0.32
s w	1.59	1.52	1.45	1.38	1.31	1.23	1.15	1.08	0.99	0.53	0.47
sw by w	2.43	2.33	2.24	2.14	2.05	1.55	1.44	1.34	1.21	1.14	1.07
w s w	3.37	3.25	3.13	3.02	2.50	2.37	2.24	2.11	1.5	1.45	1.36
w by s	4.43	4.30	4.16	4.03	3.48	3.34	3.19	3.03	2.46	2.31	2.20
West	5.00	5.46	5.31	5.17	5.02	4.46	4.30	4.13	3.55	3.39	3.26
w by n					6.21	6.07	5.52	5.36	5.19	5.04	4.53
w n w									6.44	6.32	6.22
☉ fet	6.00	6.07	6.14	6.21	6.28	6.35	6.43	6.51	5.59	7.06	7.11
Sun's Ampl	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0.00	3.03	6.06	9.10	12.12	15.19	18.15	21.31	24.41	27.13	29.5

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.26	0.28	0.25	0.31	0.33	0.34	0.36	0.38	0.40	0.41	0.42
s s w	0.53	0.57	1.00	1.04	1.07	1.10	1.14	1.17	1.21	1.24	1.27
sw by s	1.24	1.29	1.34	1.39	1.45	1.50	1.55	2.01	2.07	2.12	2.15
s w	1.59	2.06	2.14	2.21	2.28	2.36	2.43	2.51	2.59	3.06	3.11
sw by w	2.43	2.52	3.01	3.11	3.20	3.30	3.40	3.51	4.02	4.11	4.18
w s w	3.37	3.48	4.00	4.12	4.24	4.36	4.49	5.02			
w by s	4.43	4.57	5.11	5.24							
West	5.00										
☉ fet	6.00	5.53	5.46	5.35	5.32	5.25	5.17	5.09	5.01	4.54	4.49

## A Sun-Dial for the Latitude of 36 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.27	0.25	0.23	0.22	0.20	0.19	0.17	0.15	0.13	0.12	0.11
s s w	0.55	0.51	0.48	0.45	0.42	0.38	0.35	0.31	0.28	0.24	0.22
sw by s	1.26	1.21	1.11	1.11	1.05	1.00	0.55	0.49	0.44	0.39	0.35
s w	2.02	1.55	1.48	1.41	1.34	1.26	1.19	1.11	1.03	0.56	0.51
sw by w	2.45	2.36	2.27	2.18	2.08	1.59	1.49	1.39	1.28	1.19	1.12
w by w	3.39	3.28	3.17	3.05	2.53	2.41	2.29	2.16	2.03	1.51	1.42
w by s	4.45	4.32	4.19	4.05	3.52	3.38	3.23	3.08	2.52	2.38	2.27
West	6.00	5.46	5.32	5.18	5.04	4.49	4.33	4.17	4.00	3.45	3.33
w by n					6.22	6.08	5.53	5.38	5.22	5.08	4.57
w n w									6.44	6.33	6.24
☉ fet	6.00	6.07	6.15	6.22	6.29	6.37	6.45	6.53	7.01	7.08	7.14
Sun's Ampl	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0.00	3 06	6.11	9.17	12.24	15.31	18.40	21.49	25.0	27.35	29.32

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.27	0.28	0.30	0.31	0.33	0.35	0.36	0.38	0.40	0.41	0.43
s s w	0.55	0.58	1.01	1.05	1.08	1.11	1.15	1.18	1.22	1.25	1.27
sw by s	1.26	1.31	1.36	1.41	1.46	1.51	1.57	2.02	2.08	2.13	2.16
s w	2.02	2.09	2.16	2.23	2.30	2.37	2.45	2.53	3.01	3.07	3.12
sw by w	2.45	2.54	3.04	3.13	3.22	3.32	3.42	3.52	4.03	4.12	4.18
w s w	3.39	3.51	4.02	4.13	4.25	4.37	4.49	5.02			
w by s	4.45	4.58	5.11	5.25							
West	6.00										
☉ fet	6.00	5.53	5.45	5.38	5.31	5.23	5.15	5.07	4.59	4.52	4.46

## A Sun-Dial for the Latitude of 37 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	22	12	12	12	12
s by w	0.27	0.26	0.24	0.23	0.21	0.19	0.18	0.16	0.14	0.13	0.12
s s w	0.56	0.53	0.50	0.46	0.43	0.40	0.36	0.33	0.29	0.26	0.24
sw by s	1.28	1.23	1.18	1.13	1.08	1.02	0.97	0.92	0.87	0.81	0.78
s w	2.04	1.57	1.51	1.43	1.36	1.29	1.22	1.14	1.07	1.00	0.95
sw by w	2.48	2.39	2.30	2.21	2.12	2.03	1.53	1.43	1.33	1.24	1.17
w s w	3.42	3.31	3.20	3.09	2.97	2.83	2.74	2.61	2.48	2.35	2.28
w by s	4.47	4.34	4.21	4.09	3.96	3.82	3.68	3.53	3.38	3.24	3.14
West	6.00	5.47	5.33	5.19	5.06	4.52	4.37	4.21	4.05	3.50	3.39
w by n					6.22	6.08	5.54	5.40	5.24	5.11	5.00
w n w									4.44	4.33	4.25
☉ fet	6.00	6.08	6.15	6.23	6.31	6.39	6.47	6.55	7.04	7.11	7.17
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0.00	3.08	6.16	9.25	12.32	15.44	18.55	22.8	25.21	27.58	29.58

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.27	0.29	0.31	0.32	0.34	0.35	0.37	0.39	0.41	0.42	0.43
s s w	0.56	0.59	1.02	1.06	1.09	1.12	1.16	1.19	1.23	1.26	1.28
sw by s	1.28	1.33	1.37	1.42	1.47	1.53	1.58	2.04	2.09	2.14	2.17
s w	2.04	2.11	2.18	2.25	2.32	2.39	2.46	2.54	3.02	3.08	3.13
w by w	2.48	2.57	3.06	3.15	3.24	3.33	3.43	3.53	4.03	4.12	4.19
w s w	3.42	3.53	4.04	4.15	4.26	4.38	4.50	5.02			
w by s	4.47	5.00	5.12	5.25							
West	6.00										
☉ fet	6.00	5.52	5.45	5.37	5.29	5.21	5.13	5.05	4.56	4.49	4.32

## A Sun-Dial for the Latitude of 38 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.28	0.26	0.25	0.23	0.21	0.20	0.18	0.17	0.15	0.13	0.12
s s w	0.57	0.54	0.51	0.48	0.45	0.41	0.38	0.34	0.31	0.28	0.26
sw by s	1.25	1.24	1.20	1.15	1.10	1.05	1.00	0.54	0.49	0.44	0.41
s w	2.06	2.00	1.53	1.46	1.39	1.32	1.25	1.18	1.10	1.04	1.59
sw by w	2.51	2.42	2.33	2.24	2.15	2.06	1.57	1.47	1.37	1.29	1.22
w s w	3.44	3.34	3.23	3.12	3.01	2.50	2.39	2.26	2.13	2.03	1.54
w by s	4.48	4.36	4.24	4.12	4.00	3.46	3.33	3.18	3.03	2.50	2.40
West	5.07	5.47	5.34	5.21	5.08	4.54	4.41	4.25	4.09	3.55	3.45
w by n					6.32	6.09	5.56	5.41	5.26	5.14	5.04
w n w.									6.45	6.34	6.26
☉ fet	5.00	6.08	6.16	6.24	6.32	6.40	6.48	6.57	7.06	7.14	7.19
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0 00	3 10	6 21	9 31	12 43	15 56	19 11	22 26	25 43	28 43	30 24

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.28	0.30	0.31	0.33	0.34	0.36	0.38	0.39	0.41	0.42	0.44
s s w	0.57	1.00	1.04	1.07	1.10	1.13	1.16	1.20	1.24	1.27	1.29
sw by s	1.29	1.34	1.39	1.44	1.49	1.54	1.59	2.05	2.10	2.15	2.18
s w	2.06	2.13	2.20	2.27	2.34	2.41	2.48	2.55	3.03	3.07	3.14
sw by w	2.51	2.59	3.08	3.17	3.26	3.35	3.44	3.54	4.04	4.12	4.19
w s w	3.44	3.55	4.06	4.17	4.28	4.39	4.50	5.02			
w by s	4.48	5.00	5.13	5.25							
West	6.00										
☉ fet	5.00	5.52	5.44	5.36	5.28	5.20	5.12	5.03	4.54	4.46	4.41

## A Sun-Dial for the Latitude of 39 Degrees

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.29	0.27	0.25	0.24	0.22	0.21	0.19	0.17	0.16	0.14	0.13
s s w	0.58	0.55	0.52	0.49	0.46	0.43	0.39	0.36	0.32	0.30	0.27
sw by s	1.31	1.26	1.22	1.17	1.12	1.07	1.02	0.57	0.51	0.47	0.43
s w	2.09	2.02	1.55	1.49	1.42	1.35	1.28	1.21	1.13	1.07	1.02
sw by w	2.53	2.45	2.36	2.27	2.19	2.10	2.01	1.51	1.41	1.33	1.27
w s w	3.47	3.36	3.26	3.15	3.03	2.54	2.42	2.31	2.18	2.08	2.00
w by s	4.50	4.38	4.26	4.14	4.02	3.49	3.36	3.23	3.09	2.56	2.47
West	6.00	5.48	5.35	5.22	5.10	4.56	4.43	4.28	4.13	4.00	3.50
w by n					5.22	5.10	5.37	5.44	5.29	5.16	5.07
w n w									6.45	6.35	6.27
☉ set	6.00	6.08	6.16	6.24	6.32	6.41	6.50	6.59	7.09	7.16	7.22
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0.00	3.13	6.26	9.40	12.54	16.10	19.28	22.45	26.06	28.4	30.51

## SOUTH DECLINATION

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
North	12	12	12	12	12	12	12	12	12	12	12
s by w	0.29	0.30	0.32	0.33	0.35	0.36	0.38	0.40	0.41	0.43	0.44
s s w	0.58	1.02	1.05	1.08	1.11	1.14	1.18	1.21	1.25	1.27	1.30
sw by s	1.31	1.36	1.41	1.46	1.51	1.56	2.01	2.06	2.11	2.16	2.19
s w	2.09	2.15	2.22	2.29	2.35	2.42	2.49	2.57	3.04	3.10	3.15
sw by w	2.53	3.02	3.10	3.19	3.27	3.36	3.46	3.55	4.05	4.13	4.20
w s w	3.47	3.57	4.08	4.18	4.29	4.39	4.51	5.03			
w by s	4.50	5.02	5.14	5.26							
West	6.00										
☉ set	6.00	5.52	5.44	5.36	5.28	5.19	5.10	5.01	4.51	4.44	4.38

## A Sun-Dial for the Latitude of 40 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.29	0.28	0.26	0.24	0.23	0.21	0.20	0.18	0.17	0.15	0.14
s s w	1.00	0.57	0.53	0.50	0.47	0.44	0.41	0.37	0.34	0.31	0.29
sw by s	1.33	1.28	1.24	1.19	1.14	1.09	1.04	0.59	0.54	0.49	0.46
s w	2.11	2.04	1.58	1.51	1.45	1.38	1.31	1.24	1.17	1.11	1.06
sw by w	2.56	2.47	2.39	2.30	2.22	2.14	2.04	1.55	1.46	1.38	1.31
w s w	3.49	3.39	3.29	3.18	3.08	2.58	2.46	2.35	2.23	2.13	2.05
w by s	4.51	4.40	4.28	4.17	4.05	3.53	3.40	3.27	3.13	3.02	2.52
West	5.00	5.48	5.36	5.23	5.11	4.59	4.46	4.32	4.17	4.01	3.55
w by n					5.22	6.11	5.58	5.45	5.31	5.19	5.10
w n w								6.58	6.46	6.36	6.28
☉ fet	6.00	6.08	6.17	6.25	6.34	6.43	6.52	7.01	7.11	7.19	7.25
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0 00	3.15	6.32	9.48	13.6	16.24	19.45	23.06	26.30	29.16	31.22

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.29	0.31	0.32	0.34	0.35	0.37	0.38	0.40	0.42	0.43	0.44
s s w	1.00	1.03	1.06	1.09	1.12	1.15	1.18	1.22	1.25	1.28	1.30
sw by s	1.33	1.38	1.43	1.47	1.52	1.57	2.02	2.07	2.12	2.17	2.20
s w	2.11	2.17	2.24	2.31	2.37	2.44	2.51	2.58	3.05	3.11	3.16
sw by w	2.56	3.04	3.12	3.21	3.29	3.38	3.47	3.56	4.06	4.14	4.20
w s w	3.49	3.59	4.09	4.19	4.30	4.40	4.51	5.03			
w by s	4.51	5.03	5.14	5.26							
West	6.00										
☉ fet	6.00	5.52	5.43	5.35	5.26	5.17	5.08	4.59	4.49	4.41	4.35

## A Sun-Dial for the Latitude of 41 Degrees

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.30	0.28	0.27	0.25	0.24	0.22	0.21	0.19	0.17	0.16	0.15
s s w	1.01	0.58	0.55	0.52	0.49	0.46	0.42	0.39	0.36	0.33	0.31
sw by s	1.35	1.30	1.25	1.21	1.16	1.11	1.06	1.01	0.56	0.52	0.48
s w	2.13	2.07	2.00	1.54	1.48	1.41	1.34	1.27	1.20	1.14	1.09
sw by w	2.58	2.50	2.42	2.33	2.25	2.17	2.08	1.59	1.50	1.42	1.36
w s w	3.51	3.41	3.31	3.21	3.11	3.01	2.50	2.39	2.28	2.18	2.11
w by s	4.53	4.42	4.30	4.19	4.08	3.57	3.44	3.31	3.18	3.07	2.58
West	6.00	5.48	5.36	5.25	5.13	5.01	4.48	4.35	4.21	4.09	4.00
w by n					5.23	6.12	5.59	5.46	5.33	5.22	5.13
w n w								6.58	6.46	6.37	6.29
☉ fet	6.00	6.09	6.17	6.26	6.35	5.44	6.54	7.04	7.14	7.22	7.29
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0.00	3.18	6.38	9.57	13.18	16.40	20.4	23.29	26.56	29.45	31.54

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
North	12	12	12	12	12	12	12	12	12	12	12
s by w	0.30	0.31	0.33	0.34	0.36	0.37	0.39	0.40	0.42	0.44	0.45
s s w	1.01	1.04	1.07	1.10	1.13	1.16	1.19	1.23	1.26	1.29	1.31
sw by s	1.35	1.39	1.44	1.49	1.53	1.58	2.03	2.08	2.13	2.18	2.21
s w	2.13	2.19	2.26	2.32	2.39	2.45	2.52	2.59	3.06	3.12	3.17
sw by w	2.58	3.06	3.14	3.22	3.31	3.39	3.48	3.57	4.06	4.14	4.20
w s w	3.51	4.01	4.11	4.21	4.30	4.4	4.51	5.03			
w by s	4.53	5.04	5.15	5.26							
West	6.00										
☉ fet	6.00	5.51	5.43	5.34	5.25	5.16	5.06	4.56	4.46	4.38	4.31

## A Sun-Dial for the Latitude of 42 Degrees.

## NORTH DECLINATION.

Min. Deg.	1 d	2 d	3 d	4 d	5 d	6 d	7 d	8 d	9 d	10 d	11 d	12 d	13 d	14 d	15 d	16 d	17 d	18 d	19 d	20 d	21 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
s by w	0.30	0.29	0.27	0.26	0.24	0.23	0.21	0.20	0.18	0.17	0.16	0.15	0.14	0.13	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.04
s s w	1.02	0.59	0.56	0.53	0.50	0.47	0.44	0.41	0.37	0.34	0.32	0.30	0.28	0.26	0.24	0.22	0.20	0.18	0.16	0.14	0.12	0.10	0.08
sw by s	1.36	1.32	1.27	1.23	1.18	1.13	1.09	1.04	0.98	0.94	0.89	0.84	0.79	0.74	0.69	0.64	0.59	0.54	0.49	0.44	0.39	0.34	0.29
s w	2.15	2.09	2.03	1.96	1.89	1.82	1.74	1.67	1.59	1.51	1.44	1.37	1.30	1.23	1.17	1.10	1.03	0.96	0.89	0.82	0.75	0.68	0.61
sw by w	3.00	2.52	2.44	2.36	2.28	2.20	2.12	2.03	1.94	1.86	1.78	1.70	1.62	1.54	1.46	1.38	1.30	1.22	1.14	1.06	0.98	0.90	0.82
w s w	3.53	3.43	3.34	3.24	3.15	3.06	2.54	2.44	2.33	2.23	2.13	2.03	1.93	1.83	1.73	1.63	1.53	1.43	1.33	1.23	1.13	1.03	0.93
w by s	4.54	4.43	4.32	4.21	4.10	4.00	3.48	3.36	3.23	3.12	3.03	2.93	2.83	2.73	2.63	2.53	2.43	2.33	2.23	2.13	2.03	1.93	1.83
West	6.00	5.49	5.37	5.26	5.15	5.03	4.51	4.39	4.24	4.13	4.04	3.94	3.84	3.74	3.64	3.54	3.44	3.34	3.24	3.14	3.04	2.94	2.84
w by n					6.23	6.12	6.00	5.48	5.35	5.24	5.16	5.08	4.98	4.88	4.78	4.68	4.58	4.48	4.38	4.28	4.18	4.08	3.98
w n w								6.58	6.47	6.37	6.36	6.26	6.16	6.06	5.96	5.86	5.76	5.66	5.56	5.46	5.36	5.26	5.16
☉ set	5.00	6.09	6.18	6.27	6.37	6.46	6.56	7.06	7.17	7.25	7.32	7.40	7.48	7.56	8.04	8.12	8.20	8.28	8.36	8.44	8.52	9.00	9.08
Sun's Ampl.	0.00	3.21	6.44	10.6	13.31	16.56	20.23	23.52	27.24	30.16	32.28	34.40	36.52	38.64	40.76	42.88	45.00	47.12	49.24	51.36	53.48	55.60	57.72

## SOUTH DECLINATION

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
	com			com		com		com			com
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.30	0.32	0.33	0.35	0.36	0.38	0.39	0.41	0.43	0.44	0.45
s s w	1.02	1.05	1.08	1.11	1.14	1.17	1.20	1.23	1.27	1.30	1.32
sw by s	1.36	1.41	1.46	1.50	1.55	1.59	2.04	2.09	2.14	2.19	2.22
s w	2.15	2.21	2.28	2.34	2.40	2.46	2.53	3.00	3.07	3.13	3.17
sw by w	3.00	3.08	3.16	3.24	3.32	3.40	3.49	3.57	4.07	4.14	4.20
w s w	3.53	4.02	4.12	4.22	4.31	4.41	4.52				
w by s	4.54	5.04	5.15	5.26							
West	6.00										
☉ set	6.00	5.51	5.42	5.33	5.23	5.14	5.04	4.54	4.43	4.35	4.28



## A Sun-Dial for the Latitude of 43 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	22	12	12	12	12
s by w	0.31	0.29	0.28	0.27	0.25	0.24	0.22	0.21	0.19	0.18	0.17
s s w	1.03	1.00	0.57	0.54	0.51	0.48	0.45	0.42	0.39	0.36	0.34
sw by s	1.38	1.34	1.29	1.25	1.20	1.15	1.11	1.06	1.01	0.57	0.53
s w	2.17	2.11	2.05	1.59	1.53	1.47	1.40	1.33	1.26	1.20	1.16
sw by w	3.02	2.55	2.47	2.39	2.31	2.23	2.15	2.07	1.58	1.50	1.44
w s w	3.55	3.46	3.36	3.27	3.18	3.08	2.58	2.48	2.37	2.28	2.21
w by s	4.55	4.45	4.34	4.23	4.13	4.03	3.52	3.40	3.27	3.17	3.09
West	6.00	5.49	5.38	5.27	5.16	5.05	4.53	4.41	4.27	4.17	4.09
w by n					6.23	6.13	6.01	5.50	5.37	5.27	5.19
w n w								6.58	6.47	6.38	6.31
☉ fet	6.00	6.09	6.19	6.28	6.38	6.48	6.58	7.09	7.19	7.28	7.36
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0.00	3.25	6.51	10.17	13.44	17.13	20.43	24.16	27.53	30.48	33.03

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.31	0.32	0.34	0.35	0.37	0.38	0.40	0.41	0.43	0.44	0.45
s s w	1.03	1.06	1.09	1.12	1.15	1.18	1.21	1.24	1.27	1.30	1.32
sw by s	1.38	1.42	1.47	1.52	1.56	2.01	2.05	2.11	2.15	2.19	2.23
s w	2.17	2.23	2.29	2.36	2.42	2.48	2.54	3.04	3.08	3.14	3.18
w by w	3.02	3.10	3.18	3.26	3.33	3.41	3.51	3.58	4.07	4.14	4.20
w s w	3.55	4.04	4.14	4.23	4.32	4.42	4.52				
w by s	4.55	5.05	5.16	5.26							
West	6.00										
☉ fet	6.00	5.51	5.41	5.32	5.22	5.12	5.02	4.51	4.41	4.32	4.21

## A Sun-Dial for the Latitude of 44 Degrees.

## NORTH DECLINATION.

Min. Deg.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	m	h m	h m	h m	h m	h m	h m	h m	h m	m h	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.31	0.30	0.29	0.27	0.26	0.24	0.23	0.21	0.20	0.18	0.17
s s w	1.04	1.01	0.58	0.56	0.53	0.50	0.47	0.44	0.40	0.38	0.36
sw by s	1.40	1.35	1.31	1.27	1.22	1.18	1.13	1.08	1.03	0.59	0.56
s w	2.19	2.13	2.07	2.01	1.55	1.49	1.43	1.36	1.29	1.24	1.20
sw by w	3.04	2.57	2.49	2.42	2.34	2.26	2.18	2.10	2.01	1.54	1.49
w s w	3.57	3.48	3.38	3.29	3.21	3.12	3.02	2.52	2.41	2.33	2.26
w by s	4.56	4.46	4.36	4.26	4.16	4.05	3.54	3.43	3.31	3.21	3.13
West	5.00	5.50	5.39	5.28	5.18	5.07	4.56	4.44	4.31	4.21	4.13
why n					6.23	6.13	6.02	5.51	5.39	5.29	5.21
w n w								6.59	6.48	6.39	6.32
☉ set	6.00	6.10	6.19	6.29	6.39	6.49	7.00	7.11	7.22	7.31	7.39
Sun's Ampl.	0.00	3.28	6.58	30.27	13.58	17.30	21.5	24.42	28.23	31.22	33.40

## SOUTH DECLINATION

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.31	0.33	0.34	0.36	0.37	0.39	0.40	0.42	0.43	0.45	0.46
s s w	1.04	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.33
sw by s	1.40	1.44	1.48	1.53	1.57	2.02	2.06	2.11	2.16	2.20	2.23
s w	2.19	2.25	2.31	2.37	2.43	2.49	2.56	3.02	3.09	3.14	3.19
sw by w	3.04	3.12	3.19	3.27	3.35	3.42	3.51	3.59	4.08	4.15	4.20
w s w	3.57	4.06	4.15	4.24	4.33	4.42	4.52				
w by s	4.56	5.06	5.16	5.26							
West	6.00										
☉ set	6.00	5.50	5.14	5.31	5.21	5.11	5.00	4.49	4.38	4.29	4.21

## A Sun-Dial for the Latitude of 45 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	22	12	12	12	12
s by w	0.32	0.31	0.29	0.28	0.26	0.25	0.24	0.22	0.20	0.19	0.18
s s w	1.05	1.03	1.00	0.57	0.54	0.51	0.48	0.45	0.42	0.39	0.37
sw by s	1.41	1.37	1.33	1.28	1.24	1.19	1.15	1.10	1.05	1.01	0.58
s w	2.21	2.15	2.09	2.03	1.58	1.52	1.45	1.39	1.33	1.27	1.23
sw by w	3.06	2.59	2.52	2.45	2.37	2.29	2.22	2.13	2.05	1.58	1.53
w s w	3.59	3.50	3.41	3.32	3.23	3.14	3.05	2.55	2.45	2.37	2.30
w by s	4.57	4.47	4.38	4.28	4.18	4.08	3.57	3.46	3.35	3.26	3.18
West	6.00	5.50	5.40	5.30	5.19	5.09	4.58	4.46	4.35	4.25	4.17
w by n					6.24	6.14	6.03	5.52	5.41	5.31	5.24
w n w								6.59	6.48	6.40	6.33
nw by w											7.40
☉ fet	6.00	6.10	6.20	6.30	6.41	6.51	7.02	7.13	7.25	7.35	7.43
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0.00	3.32	7.05	10.38	14.13	17.49	21.28	25.09	28.56	31.58	34.20

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.32	0.33	0.35	0.36	0.38	0.39	0.41	0.42	0.44	0.45	0.46
s s w	1.05	1.08	1.11	1.14	1.17	1.20	1.23	1.26	1.29	1.31	1.33
sw by s	1.41	1.45	1.50	1.54	1.58	2.03	2.07	2.12	2.17	2.21	2.24
s w	2.21	2.27	2.33	2.39	2.44	2.51	2.57	3.03	3.10	3.15	3.19
w by w	3.06	3.14	3.21	3.28	3.36	3.44	3.51	4.00	4.08	4.15	
w s w	3.59	4.07	4.16	4.25	4.34	4.43	4.52				
w by s	4.57	5.07	5.17	5.26							
West	6.00										
☉ fet	6.00	5.50	5.40	5.30	5.19	5.09	4.58	4.47	4.35	4.25	4.17

## A Sun-Dial for the Latitude of 46 Degrees.

## NORTH DECLINATION.

Deg. Min	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.33	0.31	0.30	0.29	0.27	0.26	0.24	0.23	0.21	0.20	0.19
s s w	1.06	1.04	1.01	0.98	0.95	0.92	0.89	0.86	0.83	0.81	0.39
sw by s	1.43	1.38	1.34	1.30	1.26	1.21	1.17	1.12	1.08	1.04	0.01
s w	2.23	2.17	2.11	2.06	2.00	1.94	1.88	1.82	1.76	1.70	1.26
sw by w	3.08	3.01	2.94	2.87	2.80	2.72	2.65	2.57	2.49	2.42	1.57
w s w	4.00	3.52	3.43	3.35	3.26	3.17	3.08	2.99	2.89	2.81	2.35
w by s	5.58	4.49	4.39	4.30	4.20	4.11	4.00	3.50	3.39	3.30	3.23
West	6.00	5.50	5.40	5.30	5.20	5.11	5.00	4.49	4.38	4.28	4.21
w by n					6.24	6.14	6.04	5.54	5.44	5.33	5.26
w n w								6.59	6.49	6.41	6.34
nw by w											7.40
☉ set	6.00	6.10	6.21	6.31	6.42	6.53	7.04	7.16	7.29	7.39	7.47
Sun's Ampl.	0 00	3.36	7.12	10.50	14.28	18 9	21.52	25.39	29.31	32.37	35.3

## SOUTH DECLINATION

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.33	0.34	0.35	0.37	0.38	0.40	0.41	0.42	0.44	0.45	0.46
s s w	1.06	1.09	1.12	1.15	1.18	1.20	1.23	1.26	1.29	1.32	1.34
sw by s	1.43	1.47	1.51	1.55	2.00	2.04	2.08	2.13	2.18	2.22	2.25
s w	2.23	2.29	2.34	2.40	2.46	2.52	2.58	3.04	3.10	3.16	3.20
sw by w	3.08	3.16	3.23	3.30	3.37	3.45	3.52	4.00	4.08	4.15	
w s w	4.00	4.09	4.17	4.26	4.34	4.43					
w by s	4.58	5.08	5.17	5.26							
West	6 00										
☉ set	6 00	5.50	5.35	5.29	5.18	5.07	4.56	4.44	4.31	4.21	4.13

A Sun-Dial for the Latitude of 47 Degrees.

NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.33	0.32	0.30	0.29	0.28	0.26	0.25	0.23	0.22	0.21	0.20
s s w	1.07	1.05	1.02	0.59	0.56	0.54	0.51	0.48	0.45	0.42	0.40
sw by s	1.44	1.40	1.36	1.32	1.28	1.23	1.19	1.15	1.10	1.06	1.03
s w	2.25	2.19	2.14	2.08	2.02	1.57	1.51	1.45	1.39	1.33	1.29
sw by w	3.10	3.03	2.56	2.49	2.43	2.35	2.28	2.20	2.13	2.06	2.01
w s w	4.02	3.54	3.47	3.37	3.29	3.20	3.12	3.03	2.53	2.45	2.39
w by s	4.59	4.50	4.41	4.32	4.23	4.13	4.03	3.53	3.43	3.34	3.27
West	5.00	5.51	5.41	5.32	5.22	5.12	5.02	4.52	4.41	4.31	4.24
w by n				6.34	6.25	6.15	6.05	5.55	5.44	5.36	5.29
w n w							7.08	6.59	6.49	6.41	6.35
nw by w											7.40
☉ set	6.00	6.11	6.22	6.33	6.43	6.55	7.07	7.20	7.32	7.43	7.51
Sun's Ampl	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0.00	3.40	7.20	11.2	14.44	18.30	22.18	26.10	30.7	33.18	35.48

SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.33	0.34	0.36	0.37	0.38	0.40	0.41	0.43	0.44	0.45	0.46
s s w	1.07	1.10	1.13	1.16	1.18	1.21	1.24	1.27	1.30	1.32	1.34
sw by s	1.44	1.48	1.52	1.57	2.01	2.05	2.09	2.14	2.18	2.22	2.25
s w	2.25	2.30	2.36	2.41	2.47	2.53	2.59	3.05	3.11	3.16	3.20
sw by w	3.10	3.17	3.24	3.31	3.38	3.45	3.53	4.00	4.08	4.15	
w s w	4.02	4.10	4.18	4.26	4.35	4.43					
w by s	5.59	5.08	5.17								
West	5.00										
☉ set	6.00	5.49	5.38	5.27	5.17	5.05	4.53	4.40	4.28	4.17	4.09

## A Sun-Dial for the Latitude of 48 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.34	0.32	0.31	0.30	0.28	0.27	0.26	0.24	0.23	0.22	0.21
s s w	1.08	1.06	1.03	1.00	0.58	0.55	0.52	0.49	0.46	0.44	0.42
sw by s	1.46	1.42	1.38	1.34	1.30	1.25	1.21	1.17	1.12	1.08	1.05
s w	2.27	2.21	2.16	2.10	2.05	1.59	1.53	1.47	1.41	1.36	1.32
sw by w	3.12	3.06	2.59	2.52	2.46	2.38	2.31	2.23	2.16	2.09	2.04
w by w	4.03	3.56	3.48	3.40	3.32	3.23	3.15	3.06	2.57	2.49	2.43
w by s	5.00	4.51	4.43	4.34	4.25	4.16	4.06	3.56	3.46	3.38	3.31
West	6.00	5.51	5.42	5.33	5.23	5.14	5.04	4.54	4.43	4.35	4.28
w by n				6.34	6.25	6.16	6.06	5.56	5.46	5.38	5.31
w n w							7.08	6.59	6.50	6.42	6.36
nw by w										7.45	7.40
☉ set	6.00	6.11	6.22	6.33	6.45	6.57	7.09	7.22	7.35	7.47	7.56
Sun's Ampl.	0.00	3.44	7.29	11.15	15.2	18.52	22.45	26.43	30.45	34.43	36.35

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.34	0.31	0.30	0.30	0.30	0.40	0.42	0.43	0.45	0.46	0.47
s s w	1.08	1.11	1.14	1.16	1.16	1.22	1.25	1.28	1.31	1.33	1.35
sw by s	1.46	1.50	1.54	1.58	2.02	2.06	2.10	2.15	2.19	2.23	2.26
s w	2.27	2.32	2.37	2.43	2.48	2.54	3.00	3.05	3.12	3.17	3.21
sw by w	3.12	3.19	3.26	3.32	3.35	3.45	3.53	4.01	4.05		
w s w	4.03	4.11	4.19	4.27	4.35	4.44					
w by s	5.00	5.09	5.17	5.26							
West	6.00										
☉ set	5.00	5.49	5.38	5.27	5.15	5.03	4.51	4.38	4.25	4.13	4.04

## A Sun-Dial for the Latitude of 49 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.34	0.33	0.32	0.30	0.29	0.28	0.26	0.25	0.23	0.22	0.21
s s w	1.09	1.07	1.04	1.02	1.59	0.56	0.53	0.51	0.48	0.45	0.44
sw by s	1.47	1.43	1.39	1.35	1.31	1.27	1.23	1.19	1.14	1.11	1.08
s w	2.28	2.23	2.18	2.12	2.07	2.01	1.56	1.50	1.44	1.39	1.35
sw by w	3.14	3.07	3.01	2.54	2.48	2.41	2.34	2.27	2.19	2.13	2.08
w s w	4.05	3.57	3.50	3.42	3.34	3.26	3.18	3.09	3.00	2.53	2.47
w by s	5.01	4.53	4.44	4.36	4.27	4.18	4.09	4.00	3.50	3.42	3.35
West	6.00	5.51	5.42	5.34	5.25	5.16	5.06	4.56	4.46	4.38	4.31
w by n				6.34	6.25	6.16	6.07	5.58	5.48	5.40	5.33
w n w							7.08	7.00	6.51	6.43	6.38
nw by w										7.45	7.40
☉ fet	6.00	6.11	6.23	6.34	6.47	6.59	7.12	7.25	7.37	7.51	8.00
Sun's Ampl	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0.00	3.48	7.38	11.28	15.21	19.15	23.14	27.17	31.25	34.48	37.26

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.34	0.35	0.37	0.38	0.39	0.41	0.42	0.43	0.45	0.46	0.47
s s w	1.09	1.11	1.15	1.17	1.20	1.23	1.25	1.28	1.31	1.33	1.35
sw by s	1.47	2.51	1.55	2.59	2.03	2.07	2.11	2.15	2.20	2.23	2.26
s w	2.28	2.33	2.39	2.44	2.49	2.55	3.00	3.06	3.12	3.17	3.21
sw by w	3.14	3.20	3.27	3.34	3.40	3.47	3.54	4.01	4.09		
w s w	4.05	4.13	4.20	4.28	4.36	4.44					
w by s	5.01	5.09	5.18								
West	6.00										
☉ fet	6.00	5.49	5.37	5.26	5.13	5.01	4.48	4.35	4.21	4.09	4.00

## A Sun-Dial for the Latitude of 50 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.35	0.33	0.32	0.31	0.30	0.28	0.27	0.26	0.24	0.23	0.22
s s w	1.10	1.08	1.05	1.03	1.00	0.58	0.55	0.52	0.49	0.47	0.45
sw by s	1.48	1.45	1.41	1.37	1.33	1.29	1.25	1.21	1.16	1.13	1.10
s w	2.30	2.25	2.20	2.15	2.09	2.04	1.58	1.53	1.47	1.42	1.38
sw by w	3.16	3.09	3.03	2.56	2.50	2.43	2.36	2.30	2.23	2.16	2.12
w s w	4.06	3.59	3.51	3.44	3.36	3.29	3.21	3.13	3.04	2.57	2.51
w by s	5.02	4.54	4.45	4.37	4.29	4.20	4.12	4.03	3.53	3.45	3.39
West	5.00	5.52	5.43	5.34	5.26	5.17	5.08	4.59	4.49	4.41	4.34
w by n				6.34	6.25	6.17	6.08	5.59	5.49	5.42	5.36
w n w							7.08	7.00	6.51	6.44	6.39
nw byw										7.45	7.41
☉ fet	6.00	6.12	6.24	6.36	6.49	7.01	7.14	7.28	7.43	7.55	8.05
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0 00	3 53	7 48	11 42	15 40	19 40	23 45	27 51	32 8	36 37	38 20

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.35	0.36	0.37	0.38	0.40	0.41	0.42	0.44	0.45	0.46	0.47
s s w	1.10	1.13	1.15	1.18	1.21	1.23	1.26	1.29	1.32	1.34	1.36
sw by s	1.48	1.52	1.56	2.00	2.04	2.08	2.12	2.16	2.20	2.24	2.27
s w	2.30	2.35	2.40	2.45	2.50	2.56	3.01	3.07	3.13	3.17	3.21
sw by w	3.16	3.22	3.28	3.35	3.41	3.48	3.55	4.02	4.09		
w s w	4.06	4.14	4.21	4.29	4.36	4.44					
w by s	5.02	5.10	5.18								
West	6.00										
☉ fet	6.00	5.48	5.36	5.24	5.11	4.59	4.46	4.32	4.17	4.05	3.55



## A Sun-Dial for the Latitude of 51 Degrees

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
			30m	30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.35	0.34	0.33	0.31	0.30	0.29	0.28	0.26	0.25	0.24	0.23
s s w	1.11	1.09	1.06	1.04	1.01	0.99	0.96	0.93	0.91	0.88	0.87
sw by s	1.50	1.46	1.42	1.39	1.35	1.31	1.27	1.23	1.19	1.15	1.12
s w	2.31	2.26	2.21	2.16	2.11	2.06	2.01	1.95	1.90	1.85	1.81
sw by w	3.17	3.11	3.05	2.99	2.92	2.86	2.79	2.73	2.66	2.60	2.55
w s w	4.08	4.01	3.93	3.86	3.79	3.71	3.64	3.56	3.48	3.41	3.35
w by s	5.03	4.55	4.47	4.39	4.31	4.22	4.14	4.05	3.96	3.88	3.81
West	6.00	5.52	5.44	5.35	5.27	5.18	5.10	5.01	4.92	4.84	4.77
w by n				6.34	6.26	6.17	6.09	6.00	5.91	5.84	5.77
w n w							7.08	7.00	6.92	6.84	6.77
nw by w									7.45	7.41	
☉ fet	6.00	6.12	6.25	6.38	6.50	7.03	7.17	7.32	7.47	8.00	8.10
Sun's Ampl.	0.00	3.58	7.58	11.57	16.1	20.8	24.18	28.33	32.54	36.30	39.19

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
			30m	30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
North	12	12	12	12	12	12	12	12	12	12	12
s by w	0.35	0.36	0.38	0.39	0.40	0.41	0.42	0.44	0.46	0.47	0.48
s s w	1.11	1.14	1.16	1.19	1.21	1.24	1.27	1.29	1.32	1.34	1.36
sw by s	1.50	1.53	1.57	2.01	2.05	2.09	2.13	2.17	2.21	2.24	2.27
s w	2.31	2.36	2.41	2.46	2.52	2.57	3.02	3.07	3.13	3.18	3.21
sw by w	3.17	3.23	3.30	3.36	3.42	3.49	3.55	4.02	4.09		
w s w	4.08	4.15	4.22	4.29	4.37	4.44					
w by s	5.03	5.10	5.18								
West	6.00										
☉ fet	6.00	5.4	5.35	5.22	5.10	4.57	4.43	4.28	4.13	4.00	3.50

## A Sun-Dial for the Latitude of 52 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.36	0.34	0.33	0.32	0.31	0.30	0.28	0.27	0.26	0.25	0.24
s s w	1.12	1.10	1.08	1.05	1.03	1.00	0.57	0.55	0.52	0.50	0.48
sw by s	1.51	1.47	1.44	1.40	1.36	1.33	1.29	1.25	1.21	1.17	1.15
s w	2.33	2.28	2.23	2.18	2.13	2.08	2.03	1.58	1.52	1.48	1.44
sw by w	3.19	3.13	3.07	3.01	2.55	2.48	2.42	2.36	2.29	2.24	2.19
w s w	4.09	4.02	3.55	3.48	3.41	3.34	3.26	3.19	3.11	3.04	2.59
w by s	5.03	4.56	4.48	4.40	4.33	4.25	4.16	4.08	3.59	3.52	3.46
West	5.00	5.52	5.44	5.36	5.28	5.20	5.12	5.03	4.54	4.46	4.40
w by n				6.34	6.26	6.18	6.10	6.01	5.53	5.45	5.40
w n w							7.08	7.00	6.53	6.46	6.41
nw by w										7.45	7.41
☉ set	6.00	6.13	6.26	6.39	6.52	7.06	7.20	7.35	7.51	8.05	8.16
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0 00	4 03	8 08	12 13	16 23	20 35	24 52	29 14	33 44	37 27	40 23

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.36	0.37	0.38	0.39	0.41	0.42	0.43	0.44	0.46	0.47	0.48
s s w	1.12	1.15	1.17	1.20	1.22	1.25	1.27	1.30	1.33	1.35	1.37
sw by s	1.51	1.55	1.58	2.02	2.06	2.10	2.13	2.17	2.22	2.25	2.28
s w	2.33	2.38	2.43	2.48	2.53	2.58	3.03	3.08	3.13	3.18	3.22
sw by w	3.19	3.24	3.31	3.37	3.43	3.49	3.56	4.02	4.10		
w s w	4.09	4.16	4.23	4.30	4.37	4.44					
w by s	5.03	5.11	5.19								
West	6.00										
☉ set	6.00	5.47	5.34	5.21	5.08	4.54	4.40	4.25	4.09	3.55	3.44

## A Sun-Dial for the Latitude of 53 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.36	0.35	0.34	0.33	0.31	0.30	0.29	0.28	0.26	0.25	0.24
s s w	1.13	1.11	1.08	1.06	1.04	1.01	0.99	0.96	0.93	0.91	0.90
sw by s	1.52	1.49	1.45	1.41	1.38	1.34	1.31	1.27	1.23	1.19	1.17
s w	2.14	2.30	2.25	2.20	2.15	2.10	2.05	2.00	1.55	1.51	1.47
sw by w	3.20	3.15	3.09	3.03	2.57	2.51	2.45	3.38	2.32	2.26	2.22
w s w	4.10	4.04	3.57	3.50	3.43	3.36	3.29	3.22	3.14	3.08	3.03
w by s	5.04	4.57	4.49	4.42	4.34	4.27	4.19	4.11	4.02	3.55	3.50
West	6.00	5.52	5.45	5.37	5.29	5.22	5.13	5.05	4.56	4.49	4.43
w by n				6.34	6.26	6.19	6.11	6.03	5.54	5.47	5.42
w n w							7.08	7.01	6.53	6.47	6.42
nw by w									7.51	7.46	7.42
☉ fet	6.00	6.14	6.27	6.41	6.54	7.08	7.23	7.35	7.56	8.10	8.21
Sun's Amp.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0.00	4.09	8.19	12.31	16.46	21.5	25.28	29.59	34.36	38.29	41.29

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
		30m		30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.36	0.37	0.38	0.40	0.41	0.42	0.43	0.45	0.46	0.47	0.48
s s w	1.13	1.16	1.18	1.20	1.23	1.25	1.28	1.30	1.33	1.35	1.37
sw by s	1.52	1.56	2.00	2.03	2.07	2.10	2.14	2.18	2.22	2.25	2.28
s w	2.34	2.39	2.44	2.49	2.54	2.58	3.03	3.09	3.14	3.18	3.22
sw by w	3.20	3.26	3.32	3.38	3.44	3.50	3.56	4.03			
w s w	4.10	4.17	4.24	4.30	4.37	4.44					
w by s	5.04	5.11	5.19								
West	6.00										
☉ fet	6.00	5.46	5.33	5.19	5.06	4.52	4.37	4.21	4.04	3.56	3.39

## A Sun-Dial for the Latitude of 54 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0 37	0 35	0 34	0 33	0 32	0 31	0 29	0 28	0 27	0 26	0 25
s s w	1 14	1 12	1 09	1 07	1 05	1 02	1 00	0 57	0 55	0 53	0 51
sw by s	1 54	1 50	1 47	1 43	1 40	1 36	1 32	1 29	1 25	1 22	1 19
s w	2 36	2 31	2 27	2 22	2 17	2 12	2 08	2 03	1 57	1 53	1 50
sw by w	3 22	3 16	3 11	3 05	2 59	2 53	2 47	2 41	2 35	2 29	2 25
w by w	4 12	4 05	3 59	3 52	3 45	3 39	3 32	3 24	3 17	3 11	3 06
w by s	5 05	4 58	4 51	4 43	4 36	4 29	4 21	4 13	4 05	3 58	3 53
West	6 00	5 53	5 45	5 38	5 31	5 23	5 15	5 07	4 59	4 52	4 46
w by n				6 34	6 27	6 19	6 12	6 04	5 56	5 49	5 44
w n w							7 09	7 01	6 54	6 48	6 43
nw by w									7 51	7 46	7 42
☉ set	6 00	0 15	6 28	6 42	6 56	7 11	7 27	7 43	8 00	8 15	8 27
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0 00	4 14	8 31	12 49	17 11	21 36	26 7	30 46	35 35	39 26	42 46

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0 37	0 38	0 39	0 40	0 41	0 42	0 44	0 45	0 46	0 47	0 48
s s w	1 14	1 16	1 15	1 21	1 24	1 26	1 28	1 31	1 33	1 35	1 37
sw by s	1 54	1 57	2 01	2 04	2 08	2 11	2 15	2 19	2 23	2 26	2 28
s w	2 36	2 41	2 45	2 50	2 54	2 59	3 04	3 09	3 14	3 19	3 22
sw by w	3 22	3 27	3 33	3 39	3 41	3 50	3 56	4 03			
w s w	4 12	4 18	4 24	4 31	4 38	4 45					
w by s	5 05	5 12	5 19								
West	6 00										
iet	5 00	5 40	5 32	5 18	5 04	4 49	4 33	4 17	4 00	3 45	3 33

## A Sun-Dial for the Latitude of 55 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.37	0.36	0.35	0.34	0.33	0.31	0.30	0.29	0.28	0.27	0.26
s s w	1.15	1.13	1.10	1.08	1.06	1.03	1.01	0.99	0.96	0.94	0.92
sw by s	1.55	1.51	1.48	1.45	1.41	1.38	1.34	1.30	1.27	1.23	1.21
s w	2.37	2.33	2.28	2.24	2.19	2.14	2.10	2.05	2.00	1.55	1.52
sw by w	3.23	3.18	3.12	3.07	3.01	2.56	2.50	2.44	2.38	2.33	2.29
w s w	4.13	4.06	4.00	3.54	3.47	3.41	3.34	3.27	3.20	3.14	3.10
w by s	5.05	4.59	4.52	4.45	4.38	4.31	4.23	4.16	4.08	4.02	3.56
West	6.00	5.53	5.46	5.39	5.32	5.24	5.17	5.09	5.01	4.54	4.49
w by n				6.34	6.27	6.20	6.13	6.05	5.57	5.51	5.46
w n w							7.09	7.02	6.55	6.49	6.44
nw by w									7.51	7.44	7.42
☉ fet	6.00	6.14	6.29	6.43	6.58	7.14	7.30	7.47	8.05	8.21	8.33
Sun's Amp.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0.00	4.21	8.41	13.09	17.37	21.18	26.49	31.37	39.36	40.47	44.00

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.37	0.38	0.39	0.40	0.42	0.43	0.44	0.45	0.46	0.47	0.48
s s w	1.15	1.17	1.20	1.22	1.24	1.26	1.29	1.31	1.34	1.36	1.38
sw by s	1.55	1.58	2.01	2.05	2.08	2.12	2.16	2.19	2.23	2.26	2.29
s w	2.37	2.42	2.46	2.51	2.55	2.00	3.05	3.10	3.15	3.19	3.22
sw by w	3.23	3.29	3.34	3.40	3.45	3.51	3.57	4.03			
w s w	4.13	4.19	4.25	4.32	4.38	4.45					
w by s	5.05	5.12	5.19								
West	6.00										
☉ fet	6.00	5.46	5.31	5.17	5.02	4.46	4.30	4.13	3.55	3.39	3.27

## A Sun-Dial for the Latitude of 56 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.37	0.36	0.35	0.34	0.33	0.32	0.31	0.30	0.28	0.27	0.26
s s w	1.16	1.14	1.11	1.09	1.07	1.05	1.02	1.00	0.57	0.55	0.53
sw by s	1.56	1.53	1.49	1.46	1.43	1.39	1.36	1.32	1.28	1.26	1.23
s w	2.39	2.34	2.30	2.26	2.21	2.16	2.12	2.07	2.02	1.59	1.55
sw by w	3.25	3.19	3.14	3.09	3.03	2.58	2.52	2.46	2.40	2.36	2.32
w s w	4.14	4.08	4.02	3.56	3.50	3.43	3.37	3.30	3.23	3.17	3.13
w by s	5.06	5.00	4.53	4.46	4.40	4.33	4.26	4.18	4.11	4.05	4.00
West	6.00	5.53	5.46	5.39	5.32	5.26	5.18	5.11	5.03	4.57	4.52
w by n				6.34	6.28	6.21	6.14	6.06	5.59	5.53	5.48
w n w						7.15	7.09	7.02	6.55	6.50	6.45
									7.51	7.46	7.43
☉ fet	6.00	6.15	6.30	6.45	7.00	7.16	7.34	7.52	8.11	8.27	8.41
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0.00	4.28	8.57	13.29	18.5	22.46	27.34	32.32	37.43	42.4	45.27

## SOUTH DECLINATION

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.37	0.39	0.40	0.41	0.42	0.43	0.44	0.45	0.47	0.48	0.48
s s w	1.16	1.18	1.20	1.22	1.25	1.27	1.29	1.32	1.34	1.36	1.38
sw by s	1.56	1.59	2.02	2.06	2.09	2.13	2.16	2.20	2.24	2.26	2.29
s w	2.39	2.43	2.47	2.52	2.56	3.01	3.06	3.10	3.15	3.19	
sw by w	3.25	3.30	3.35	3.40	3.46	3.51	3.57	4.03			
w s w	4.14	4.20	4.26	4.32	4.38						
w by s	5.06	5.13	5.19								
West	6.00										
☉ fet	6.00	5.45	5.30	5.15	5.00	4.44	4.26	4.08	3.49	3.33	3.19

## A Sun-Dial for the Latitude of 57 Degrees

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
			30m	30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.38	0.37	0.36	0.35	0.34	0.32	0.31	0.30	0.29	0.28	0.27
s s w	1.17	1.14	1.12	1.10	1.08	0.06	1.04	1.01	0.59	0.57	0.55
sw by s	1.57	1.53	1.51	1.47	1.44	1.41	1.37	1.34	1.50	1.27	1.25
s w	2.40	2.36	2.31	2.27	2.23	2.18	2.14	2.10	2.05	2.01	2.58
sw by w	3.26	3.21	3.16	3.11	3.05	3.00	2.55	2.49	2.43	2.28	2.34
w s w	4.15	4.09	4.03	3.57	3.51	3.45	3.39	3.33	3.26	3.20	3.16
w by s	5.07	5.01	4.54	4.47	4.41	4.34	4.28	4.21	4.13	4.07	4.03
West	6.00	5.53	5.47	5.40	5.33	5.27	5.20	5.12	5.05	4.59	4.54
w by n				6.34	6.28	6.21	6.14	6.07	6.00	5.54	5.50
w n w						7.15	7.09	7.03	6.56	6.51	6.46
nw by w									7.51	7.47	7.43
n w											8.38
☉ fet	6.00	6.16	6.31	6.47	7.03	7.27	7.38	7.56	8.16	8.34	8.48
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	6.00	4.35	9.11	13.52	18.33	23.24	28.23	33.31	38.53	43.27	47.2

## SOUTH DECLINATION.

Deg. Min.	5 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
			30m	30m		30m		30m			29m
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
North	12	12	12	12	12	12	12	12	12	12	12
s by w	0.38	0.39	0.40	0.41	0.42	0.43	0.44	0.46	0.47	0.48	0.49
s s w	1.17	1.19	1.21	1.23	1.25	1.27	1.30	1.32	1.34	1.36	1.38
sw by s	1.57	2.00	2.03	2.07	2.10	2.13	2.17	2.20	2.24	2.27	2.29
s w	2.40	2.44	2.48	2.53	2.57	3.02	3.06	3.10	3.15	3.19	
sw by w	3.26	3.31	3.36	3.41	3.46	3.51	3.57	4.03			
w s w	4.15	4.21	4.26	4.32	4.38						
w by s	5.07	5.13	5.19								
West	6.00										
☉ fet	5.00	5.44	5.29	5.13	4.57	4.40	4.22	4.04	3.44	3.26	3.12

## A Sun-Dial for the Latitude of 58 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0 38	0 37	0 36	0 35	0 34	0 33	0 32	0 31	0 30	0 29	0 28
s s w	1 17	1 15	1 13	1 11	1 09	1 17	1 05	1 02	1 00	0 58	0 57
sw by s	1 58	1 55	1 52	1 49	1 46	1 42	1 39	1 36	1 32	1 29	1 27
s w	2 41	2 37	2 33	2 29	2 25	2 20	2 16	2 12	2 07	2 04	2 01
sw by w	3 27	3 22	3 17	3 12	3 07	3 02	2 57	2 51	2 46	2 41	2 38
w by w	4 16	4 10	4 05	3 59	3 53	3 47	3 41	3 35	3 29	3 23	3 19
w by s	5 07	5 01	4 55	4 48	4 43	4 36	4 30	4 23	4 16	4 10	4 06
West	6 00	5 54	5 47	5 41	5 34	5 28	5 21	5 14	5 08	5 02	4 57
w by n				6 34	6 28	6 22	6 15	6 08	6 02	5 56	5 51
w n w						7 16	7 10	7 03	6 57	6 52	6 48
nw by w							7 57	7 51	7 44	7 38	7 33
n w											
☉ set	6 00	6 16	6 32	6 48	7 06	7 24	7 42	8 01	8 22	8 41	8 56
Sun's Am. H.	0 00	4 43	7 26	10 10	12 53	15 36	18 19	21 02	23 45	26 28	29 11

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0 38	0 39	0 40	0 41	0 43	0 44	0 45	0 46	0 47	0 48	0 49
s s w	1 17	1 19	1 22	1 24	1 26	1 28	1 30	1 32	1 33	1 37	1 38
sw by s	1 58	2 01	2 04	2 07	2 10	2 14	2 17	2 21	2 24	2 27	2 29
s w	2 41	2 44	2 49	2 53	2 57	3 02	3 06	3 10	3 15	3 19	
sw by w	3 27	3 32	3 37	3 42	3 47	3 52	3 57				
w s w	4 16	4 21	4 27	4 33	4 38						
w by s	5 07	5 13	5 19								
West	6 00										
☉ set	6 00	5 44	5 28	5 11	4 54	4 36	4 18	3 59	3 38	3 19	3 04



## A Sun-Dial for the Latitude of 59 Degrees.

## NORTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.39	0.38	0.37	0.36	0.35	0.34	0.32	0.31	0.30	0.29	0.29
s s w	1.18	1.16	1.14	1.12	1.10	1.08	1.06	1.04	1.01	1.00	0.58
sw by s	1.59	1.56	1.53	1.50	1.47	1.44	1.41	1.38	1.34	1.31	1.29
s w	2.42	2.38	2.35	2.31	2.27	2.23	2.19	2.14	2.10	2.06	2.03
sw by w	3.28	3.24	3.19	3.14	3.09	3.04	2.59	2.54	2.49	2.44	2.41
w s w	4.17	4.12	4.06	4.01	3.55	3.49	3.43	3.38	3.32	3.26	3.22
w by s	5.08	5.02	4.56	4.50	4.44	4.38	4.32	4.25	4.19	4.13	4.09
West	6.00	5.54	5.48	5.42	5.35	5.29	5.23	5.16	5.09	5.04	4.59
w by n				6.35	6.29	6.22	6.16	6.10	6.03	5.58	5.53
w n w						7.16	7.10	7.04	6.58	6.53	6.49
nw by w								7.57	7.52	7.48	7.44
n w										8.42	8.38
☉ fet	6.00	6.16	6.33	6.50	7.08	7.27	7.46	8.07	8.29	8.49	9.05
Sun's Amp.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0.00	4.51	7.43	14.41	19.41	24.53	30.12	35.43	41.37	46.40	59.42

## SOUTH DECLINATION.

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.39	0.40	0.41	0.42	0.43	0.44	0.45	0.46	0.47	0.48	0.49
s s w	1.18	1.20	1.22	1.24	1.26	1.28	1.31	1.33	1.35	1.37	1.38
sw by s	1.59	2.02	2.05	2.08	2.11	2.14	2.18	2.21	2.24	2.27	2.29
s w	2.42	2.46	2.50	2.54	2.58	3.02	3.06	3.11	3.15		
sw by w	3.28	3.33	3.38	3.43	3.47	3.52	3.57				
w s w	4.17	4.22	4.28	4.33	4.39						
w by s	5.08	5.14	5.19								
West	6.00										
☉ fet	6.00	5.44	5.27	5.10	4.52	4.33	4.14	3.53	3.31	3.11	2.55

## A Sun-Dial for the Latitude of 60 Degrees.

## NORTH DECLINATION.

Min. Deg.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.39	0.38	0.37	0.36	0.35	0.34	0.33	0.32	0.31	0.30	0.29
s s w	1.15	1.17	1.15	1.13	1.11	1.09	1.07	1.05	1.03	1.01	1.00
w by s	2.00	1.57	1.54	1.51	1.48	1.45	1.42	1.39	1.36	1.33	1.31
s w	2.44	2.40	2.36	2.32	2.28	2.24	2.20	2.16	2.12	2.08	2.06
w by n	3.29	3.25	3.20	3.16	3.11	3.05	3.01	2.56	2.51	2.47	2.44
w s w	4.11	4.13	4.07	4.02	3.57	3.51	3.46	3.40	3.34	3.29	3.25
w by s	5.08	5.03	4.57	4.51	4.45	4.40	4.34	4.27	4.21	4.16	4.12
West	6.00	5.54	5.48	5.42	5.36	5.31	5.24	5.18	5.11	5.06	5.02
w by n				6.35	6.29	6.23	6.17	6.11	6.04	5.59	5.55
w n w						7.16	7.10	7.04	6.59	6.54	6.50
n w by w								7.57	7.52	7.48	7.45
n w										8.41	8.39
☉ fet	6.00	5.17	5.35	6.50	7.11	7.30	7.51	8.13	8.36	8.58	9.16
Sun's Ampl.	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m	d m
	0 0	5.00	10.2	15.8	20.18	24.39	28.09	31.58	35.10	38.32	41.5

## SOUTH DECLINATION

Deg. Min.	0 d	2 d	5 d	7 d	10 d	12 d	15 d	17 d	20 d	22 d	23 d
Point	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
South	12	12	12	12	12	12	12	12	12	12	12
s by w	0.34	0.40	0.41	0.42	0.43	0.44	0.45	0.46	0.47	0.48	0.49
s s w	1.19	1.21	1.23	1.25	1.27	1.29	1.31	1.33	1.35	1.37	1.38
sw by s	2.00	2.03	2.06	2.09	2.12	2.15	2.18	2.21	2.24	2.27	2.29
s w	2.44	2.47	2.51	2.55	2.59	3.03	3.07	3.11	3.15		
w by w	3.29	3.34	3.38	3.43	3.48	3.53	3.58				
w s w	4.18	4.23	4.28	4.33	4.39						
w by s	5.08	5.14	5.20								
West	6.00										
☉ fet	5.00	5.43	5.25	5.08	4.49	4.30	4.09	3.47	3.24	3.00	2.41

*The Description and Use of the foregoing Sun-Dial TABLES.*

THESE Tables are intituled at the Head of each Page thus: *A Sun-Dial for the Latitude of 0 Degree*; the next is, *A Sun-Dial for the Latitude of 1 Degree*, and so on orderly unto 60 Degrees, making in all 61 Dials; from Page 24 to Page 84.

Each Dial hath two Tables, the uppermost for North Declination, the lowermost for South Declination, and 12 Columns in each Table: At the Head of each Column, and right against Deg. Min. are the Degrees of Declination thus; | 0d. | 2d. 30m. | 5d. | 7d. 30m. | 10d. 12d. 30m. | 15d. | 17d. 30m. | 20d. | 22d. 23d. 29m. d. standing for Degrees, and m. for Minutes.

Under those Degrees and Minutes of Declination in each Column is set h. m. h. stands for Hours, and m. for Minutes of an Hour.

In the Left-hand Column of each Table under Points, at the Head, are the Points of the Compass, thus. South, S. by W. SSW. SW. by S. SW. &c. S. by W. standing for South and by West; SSW. for South South West; SW. by S. for South West by South, and so for the rest.

At the Foot of each Table, is the Sun's Setting and Sun's Amplitude, agreeable to those several Declinations at the Head of each Column; and are distinguished from the rest by the Words in the Left-hand Column, thus, ☉ set, Sun's Amplitude, or so much of them as the Column can contain. *Note*, the Sun's setting is annexed to each Table, but the Sun's Amplitude only to that for North Declination, because it's the same (as to Quantity) for South Declination.

The Sun's setting is Hours and Minutes, but the Amplitude is Degrees and Minutes, having (d) over the Degrees, and m over the Minutes.

By these Tables (being Sun Dials for all Latitudes) may be known the Time of the Day, the Sun being visible in any Part of the Hemisphere as true and exact as though he was upon the Meridian; Also his Rising, Setting, and Amplitude. The like may be known by any Star, whose Declination doth not exceed 23d. 29m. as will be evident by the following Propositions.

*Proposition 1.* **T**HE Latitude of a Place, the Sun's Declination, and his Bearing being given; to find the Hour of the Day.

*Note,* By Bearing is meant the Azimuth or Point of the Compass he is upon; and that is found by setting the Sun with an Azimuth Compass, which is the truest Way, proper Allowance being made for the Variation, and is to be preferred before setting the Sun with a common Compass.

*The Resolution of this Proposition is thus;*

1. Seek in the *Sun Dial Tables* for the given Latitude.
2. At the Head of the Table seek the given Declination, or the nearest to it.
3. Find the given Bearing among the Points of the Compass in the Left-hand Column.
4. Then look straight to the Right-hand of the Bearing, till you come right under the Declination (before found) in the Head of the Table, and what Number you find there is the Hour required.

*Example 1.* In the Latitude of 30 Degrees, the Sun having 15 Degrees North Declination, I desire to know at what o'clock the Sun cometh upon the SW. Point of the Compass?

Look for the Table belonging to the Latitude of 30 Degrees, which is in Page 54, and in the Head thereof, seek for 15 Degrees in the Column under North Declination, and on its Left-hand Side for SW. and then in the common Angle of Meeting you will find the Hour of the Day to be oh. 58m. that is 58 Min. past 12 o'Clock, the Time required.

*Example*

*Example 2.* I desire to know at what o'Clock the Sun cometh to the SW. in the Latitude of 30 Degrees, his Declination being 15 Degrees South? *Answer;* 34 Minutes past 2 o'Clock.

For if you turn to the Dial for Latitude 30 Degrees, in Page 54, and in the Table for South Declination seek 15d. at the Head of it, under which, and right against SW. (on the Left-hand) you will find 2h. 34m. the Time of the Day required.

If the Declination be not the same with the Declination in the Head of the Table; then look under that Declination which is nearest to the Declination proposed.

But more exactly thus, *Find the Hour for the next Declination both less and greater than the Declination proposed*, and take the Difference of those Hours, as also of the Declination belonging to them: Then say,

As the last Difference is to the first Difference; so is the Difference between the Declination proposed and the next less in the Table, to a fourth proportional, which add to (*when the Hour in the Table increaseth*) or (*when it decreaseth*) subtract from the Hour belonging to the less Declination aforesaid, and you will have the Hour required exact to the Declination proposed.

*Example 3.* Admit the Declination to be 18 Deg. 20 min. North, I desire to know at what o'Clock the Sun cometh upon the WSW. Point of the Compass, in the Latitude of 30 Degrees?

In the Table, the nearest Number to 18 Deg. 20 Min. is 17d. 30m. Then under 17d. 30m. and against WSW. is 1h. 42m. which sheweth that the Sun cometh upon the WSW. Point of the Compass, at 42 Min. past one o'Clock.

Now because the Declination proposed, and the Declination in the Head of the Table are somewhat different; therefore you may make a Proportion very easily, thus, under 17d. 30m. and against WSW. you will find

1h. 42m. and under 20d. 00m. you'll find 1h. 25m. the difference between these two Numbers is 17m. And the difference between the Declination 17d. 30m. and 20d. is 2d. 30m. or 150m. Also the difference between the Declination 18d. 20m. and 17d. 30m. is 50m. Then say, As 150m. is to 17m. so is 50m. to 6m. almost: But because 50 is  $\frac{2}{3}$  of 150, therefore the Third Part of 17m. is near 6m. which subtracted from 1h. 42m. (because the Hour decreaseth) and the Remainder 1h. 36m. is the true Hour of the Day, the Sun being upon the W. S W. Point of the Compass, having 18d. 20m. North Declination.

Do the like with any other Degrees and Minutes of Declination: But if the Declination be not very different from that in the Head of the Table, you need not make any Proportion: Likewise when the Sun is near the Meridian, you need not make any Proportion, because there the difference is but small.

*Note,* There are none but the *Afternoon Points* in the Tables of these *Dials*, yet you may easily find the Time of the Day for the *Forenoon Points* by what follows.

For Points equally distant from the Meridian, are equal Time from Noon, so that at what space of Time from Noon the Sun is S.E. in the Forenoon, the like space of Time from Noon he is S.W. Afternoon.

As in the Table following, the Points that stand right against one another, are equally distant from the Meridian; therefore to find the Hour of the Day, the Sun being upon any of the Forenoon Points; see what Time of the Day it is when the Sun is upon the Afternoon Points that stand right against the Forenoon Points desired, and subtract those Hours and Minutes from 12 Hours, the Remainder is the Hour and Minute of the Day required.

A TABLE

A TABLE of the Points of the Compass, equally distant from the Meridian.

Forenoon Points.	Afternoon Points.
South	South
South by East	South by West
South South East	South South West
South East by South	South West by South
South East	South West
South East by East	South West by West
East South East	West South West
East by South	West by South
East	West
East by North	West by North
East North East	West North West
North East by East	North West by West
North East	North West
North East by North	North West by North
North North East	North North West
North by East	North by West
North	North
Forenoon Points.	Afternoon Points.

*Example 4.* In the Latitude of 60 Degrees, the Sun being North East; I demand the Hour of the Day, the Sun having 22 Degrees North Declination.

In the *Sun-Dial* for Latitude 60 Degrees, (in Page 84) look against NW. which is the *Afternoon Point*, corresponding to N.E. the *Forenoon Point*) and finding the Declination 22 Degrees in the Head of the Table, in the common Angle of Meeting is 8 Hours 41 Minutes, which subtract from 12 Hours, the Remainder 3 Hours 19 Minutes, is the Hour of the Day required in the Morning.

*Example*

*Example 5.* The Sun being ENE. in the same Latitude with the same Declination; I demand the Hour of the Day?

In Latitude 60 Degrees, and North Declination 22 Degrees, the Sun being WNW. it is 54 Minutes past six o'Clock in the Afternoon; which subtract from 12 Hours, the Remainder is 6 Minutes past 5 in the Morning; the Time desired.

*Example.* In the Latitude 35 Degrees North, the Sun having 15 Degrees North Declination; and being South East by East; I demand the Hour and Minute of the Day?

In the Table for Latitude 35 Degrees (in Page 59) look against SW. by W. (the Afternoon Point) correspondent to SE. by E. (the Forenoon Point.) And the Declination 15d. at the Head of the Table, and in the common Angle of Meeting is 1h. 45m. which deducted from 12 Hours, the Remainder is 15 Min. past 10 o'Clock, the true Time of the Day desired.

*Example 7.* In the Latitude 35 Degrees North, the Sun having 15 Degrees South Declination, and being SE. by E. I demand the Hour of the Day.

*Answer,* 20 Minutes past 8 o'clock; for the Hour in the Table is 3 Hours 40 Minutes, which subtracted from 12 Hours, leaveth 8 Hours 20 Minutes the Hour required.

The like is to be understood of any other Latitude, with any other Declination, and with any other Point of the Compass.

*Note,* These Tables serve as well in *South Latitude*, as in *North Latitude*, the only Difference will be this:

If the Latitude be contrary, then the Declination must be contrary, and the Points of the Compass contrary; that is to say, North Declination must be counted South; and South Declination must be counted North; and the South Point



Point must be North ; and S. by W. must be N. by W. and S.S.W. must be N.N.W. and S.W. by S. must be NW. by N. and so for any other Point, as in the following Table.

A TABLE of Points equally distant from Noon, both in North Latitude and in South Latitude, either before Noon or after Noon.

North Latitude.		South Latitude.	
Forenoon.	Afternoon.	Forenoon.	Afternoon.
S. by E. S. S. E. S. E. by S. South East	S. by W. S. S. W. S. W. by S. South West	N. by E. N. N. E. N. E. by N. North East	N. by W. N. N. W. N. W. by N. North West.
S. E. by E. E. S. E. E. by S. East.	S. W. by W. W. S. W. W. by S. West	N. E. by E. E. N. E. E. by N. East	N. W. by W. W. N. W. W. by N. West
E. by N. E. N. E. N. E. by E. North East	W. by N. W. N. W. N. W. by W. North West	E. by S. E. S. E. S. E. by E. South East	W. by S. W. S. W. S. W. by W. South West.
N. E. by N. N. N. E. N. by E. North	N. W. by N. N. N. W. N by W. North	S. E. by E. S. S. E. S. by E. South	S. W. by S. S. S. W. S. by W. South

Proposition 2 *To find the Hour of the Night by the Stars, and the Tables of Sun-Dials.*

**Y**OU may find the Hour of the Night by the Bearing of any known Star, whose Declination doth not exceed the Sun's greatest Declination, after this Manner.

Find

Find the Time of the Star's coming to the Meridian on the Day proposed; then if the Star be on the East Side of the Meridian, subtract the Hours and Minutes which these Tables shews, from the Time of the Star's coming to the Meridian, the Remainder is the Hour of the Night: But if the Star be on the West Side of the Meridian, then add those Hours and Minutes abovesaid, to the Time of the Star's coming to the Meridian, the Sum is the Hour of the Night.

To find what Time the Stars come upon or to the Meridian, see the *Mariner's Calendar*; in the Uses of the Tables of the Sun's and Stars Right Ascension, Pages 57, 58, 59, 60, and 61.

*Example 8.* Admit the 26th of *October* 1779, in the Latitude 40 Degrees North, I observe the *Bull's-Eye* to be S.E. I demand the Hour of the Night?

The 26th of *October*, 1779, the *Bull's Eye* cometh on the Meridian at 19 Minutes past 2 o'Clock in the Morning; this Star's Declination is 16 Deg. North, therefore in the Table that belongs to 40 Degrees in Page 64, seek in the Head of the Table the Declination of the Star, or nearest thereto, and by the Side, the Point of the Compass, and in the common Angle of Meeting, is 1h. 31m. which subtract from 2h. 19m. the Star's Southing, the Remainder 0 hours 48 min. is the Hour of the Night desired. But if this Star had born S.W. you must have added, and then the Hour would have been 50 min. past 3 o'Clock in the Morning.

*The Operation.*

	h.	m.
The Time of the Stars being on the Meridian——	2	19
His Distance from the Meridian either at S.E. or S.W. 1	3	1
<hr/>		
The Time of the Night, the Star being S.E.——	0	48
<hr/>		
The Time of the Night, the Star being S.W.——	3	50
<i>Example</i>		

*Example 9.* Admit the 16th Day of November, in Latitude 45 Degrees North; I see the *Lyon's Tail* upon the ESE. Point of the Compass, having Declination 15d. 57m. North, I demand the Hour of the Night.

*The Operation.*

	h. m.
Time of the Star's being on the Meridian	08 : 10 Morn.
His Distance from the Meridian being —	03 : 02
Time of the Night, the Star is E. S. E.	05 : 08 Morn.
Time when this Star is W.S.W.	11 : 12 Morn.

*Note,* If the Compass hath Variation, you must allow for the Variation; but if you will use this following Instrument, which I call the Rectifier, you need not reckon which Way the Variation is, either Eastward or Westward; for this Instrument will do it so plain, that you cannot be mistaken, as is shewn in the following Part of this Book: But for the present I will only give you one Proposition, and apply it upon the Rectifier, which is as followeth:

*Proposition.* Admit in Lat. 47 Deg. North, the Sun being in one of the Equinoctial Points, at which Time he hath no Declination, I observe the Sun to rise upon the E.S.E. Point of the Compass, I demand the Variation?

The Sun having no Declination, in any Latitude, (if there be no Variation) the Sun will rise at East, and set at West; but according to the foregoing Proposition, the Sun did rise E.S.E. therefore there are two Points Variation, as will appear by the following Rectifier.

*The Description of the RECTIFIER.*

THIS Instrument containeth two Circles or Compasses one within the other; but as it is made of Wood, the one moveth upon the other; so that the inward, or upper

upper Circle representeth the Compass that you steer by, which is subject to Variation : But the outward or under Circle representeth a true Compass that never varieth. And by it you may readily rectify your Compass when it doth vary ; thus.

Always bring the true Point of Rising or Setting on the outward or under Compass to touch the false Point of Rising or Setting on the inward or upper Compass, there let the Instrument stand.

As in the foregoing *Proposition* ; The East Point is the true Point of Rising, and ESE. Point is the false Point of Rising ; therefore bring the East Point on the outward or under Compass, to touch the ESE Point on the inward or upper Compass.

Then the Points that are on the outward or true Compass do explain the Points that are upon the inward or steering Compass ; so that according to this Observation the NNE. Point on your Compass, is the true North Point ; and the North is the true NNW. and the NW. is the true WNW. and the West the true WSW. Point ; as plainly appears by the Rectifier.

*Note,* The true Points are always counted on the outward Circle or Compass.

This Instrument in Wood, is larger than this Figure, and there the Points are divided into Halves and Quarters ; as also each Compass (in some) is divided into 360 Degrees numbered from the North and South, (both ways) towards the East and West, ending there in 90 Degrees.

A right Knowledge of the Quantity and Quality of the *Variation* of the Compass in different Latitudes and Longitudes, is of the utmost Importance, not only in the preceding *Proposition*, but in all others where *Bearings* are required, and especially in correcting the Courses steered by a Ship at Sea ; for which Purpose an accurate Variation Chart constructed from more than Fifty Thousand actual Observations, by *William Mountaine, F. R. S.* is sold by Mess. *Mount and Page*, on Tower Hill.

The RECTIFIER.



Proposition 3. *To find the Sun's Rising, Setting, or Amplitude by the Tables of the Sun's Dials.*

**I**N the Table for the Latitude of the Place, seek the Declination, under which, and against  $\odot$  set, is the Sun's Setting; and against *Sun's Ampl.* is the Amplitude.

And

And if you subſtraſt the Sun's Setting from 12 Hours, it gives its Riſing.

*Example 10.* Latitude 50 Degrees North, Sun's Declination 20 Degrees North, I demand his Riſing, Setting, and his Amplitude.

In the Table for 50 Degrees (in Page 74) ſeek the Declination 20 Degrees North at the Head of the Table, under which, and right againſt *☉ ſet* is 7.43, which ſheweth the Sun ſetteth at 43 Minutes after 7 in the Afternoon; which ſubtraſt from 12h. the Remainder 4h. 17m. is his Riſing.

In like Manner under the Sun's Declination 20d. and againſt Sun's Amp. is 32d. 8m. the Sun's Amplitude; that is, Eaſt Northerly at his Riſing, but Weſt Northerly at his Setting.

*Note 1.* The Amplitude is always of the ſame Name with the Declination, for that Reaſon the Amplitude is ſet only for North Declination, being the ſame in Quantity for South Declination, only in Quality it is the contrary.

*Note 2.* The Sun's Riſing for North Declination, is the Setting for South Declination: For that Reaſon, the Table hath only *☉ ſet*, both for North and South Declination: Yet they ſerve for both Riſing and Setting, by looking contrary to the given Declination.

Wherefore to find the Sun's Riſing when he hath North Declination, look under South Declination; and when he hath South Declination (to find his Riſing) look under North Declination.

*Note 3.* In South Latitude with South Declination, alſo in South Latitude with North Declination, the Sun's Riſing and Setting is the ſame as in North Latitude with North Declination, as alſo in North Latitude with South Declination. There

Therefore these Tables are as useful in South Latitude as in North Latitude; if North Declination in these Tables be counted for South, and South for North.

Note 4. The Rising, Setting, and Amplitude of any Star (whose Declination doth not exceed the Sun's greatest Declination) may be found by these Tables; provided it's Southing, or Time of the Star's coming to or on the Meridian, be known.

For the Time of Sun-setting in these Tables for any Latitude, is a Star's half Continuance above the Horizon, having equal Declination, and the same kind with the Sun for the same Latitude.

Therefore the half Continuance of a Star above the Horizon (found in these Tables as before directed) added to, and subtracted from the Time of the Star's coming to or on the Meridian; the first is the Star's Setting, and the latter it's Rising.

Examples of this Nature you will find in the Use of the next Tables of Semidiurnal and Seminocturnal Arches, to which you are referred.

The Amplitude of a Star by the foregoing Tables is found as the Amplitude of the Sun was, which is more fully treated on in the Use of the Table of Amplitude in Page 146.



Astronomic TABLES of Semidiurnal and Seminocturnal Arches: Shewing the true Time of the Sun's Rising and Setting; with the Length of the Day and Night, for any Day in the Year; fitting all Places in the World, where the Pole is not elevated above 60 Degrees, either North or South; and to last with Exactness, as long as God upholdeth the Course of Nature.

A T A B L E shewing the Semidiurnal Arch, or Time of Sun-setting, when the Sun hath North Declination; and the Seminocturnal Arch, or Time of Sun-rising, when the Sun hath South Declination.

### The Degrees of Latitude.

Sun's Decl.	1		2		3		4		5		6	
	H	M	H	M	H	M	H	M	H	M	H	M
0	06	00	06	00	06	00	06	00	06	00	06	00
1	06	00	06	00	06	00	06	00	06	00	06	00
2	06	00	06	00	06	00	06	00	06	01	06	00
3	06	00	06	00	06	01	06	01	06	01	06	01
4	06	00	06	00	06	01	06	01	06	01	06	02
5	06	00	06	00	06	01	06	01	06	02	06	02
6	06	00	06	01	06	01	06	02	06	02	06	03
7	06	00	06	01	06	01	06	02	06	02	06	03
8	06	00	06	01	06	02	06	02	06	03	06	03
9	06	01	06	01	06	02	06	03	06	03	06	04
10	06	01	06	01	06	02	06	03	06	04	06	04
11	06	01	06	01	06	02	06	03	06	04	06	05
12	06	01	06	02	06	02	06	03	06	04	06	05
13	06	01	06	02	06	03	06	04	06	05	06	06
14	06	01	06	02	06	03	06	04	06	05	06	06
15	06	01	06	02	06	03	06	04	06	05	06	06
16	06	01	06	02	06	03	06	05	06	06	06	07
17	06	01	06	02	06	04	06	05	06	06	06	07
18	06	01	06	03	06	04	06	05	06	07	06	08
19	06	01	06	03	06	04	06	05	06	07	06	08
20	06	01	06	03	06	04	06	06	06	07	06	09
21	06	02	06	03	06	05	06	06	06	08	06	09
22	06	02	06	03	06	05	06	06	06	08	06	10
23	06	02	06	03	06	05	06	07	06	09	06	10
23.29	06	02	06	04	06	05	06	07	06	09	06	11



A TABLE shewing the Semidiurnal Arch, or Time of Sun-setting, when the Sun hath North Declination; and the Seminocturnal Arch, or Time of Sun-rising, when the Sun hath South Declination.

The Degrees of Latitude.

Sun's Decl.	7		8		9		10		11		12	
	H	M	H	M	H	M	H	M	H	M	H	M
0	06	00	06	00	06	00	06	00	06	00	06	00
1	06	00	06	00	06	01	06	01	06	01	06	01
2	06	01	06	01	06	01	06	01	06	02	06	02
3	06	01	06	02	06	02	06	02	06	02	05	03
4	06	02	06	02	06	02	06	03	06	03	06	04
5	06	02	06	03	06	03	06	04	06	04	06	04
6	06	03	06	03	06	04	06	04	06	05	06	05
7	06	03	06	04	06	04	06	05	06	05	06	06
8	06	04	06	04	06	05	06	06	06	06	06	07
9	06	04	06	05	06	06	06	06	06	07	06	08
10	06	05	06	06	06	06	06	07	06	08	06	09
11	06	05	06	06	06	07	06	08	06	09	06	09
12	06	06	06	07	06	08	06	09	06	09	06	10
13	06	06	06	07	06	08	06	09	06	10	06	11
14	06	07	06	08	06	09	06	10	06	11	05	12
15	06	08	06	09	06	10	06	11	06	12	06	13
16	06	08	06	09	06	10	06	12	06	13	06	14
17	06	09	06	10	06	11	06	12	06	14	06	15
18	06	09	06	10	06	12	06	13	06	14	06	16
19	06	10	06	11	06	13	05	14	06	15	06	17
20	06	10	06	12	06	14	06	15	06	16	06	18
21	06	11	06	12	06	14	06	16	06	17	06	19
22	06	11	06	13	06	15	06	16	06	18	06	20
23	06	12	06	14	06	15	06	17	06	19	06	21
23.29	06	12	06	14	06	16	06	17	06	19	06	21

Suppose  
at Sol.  
y Solstice  
to 20<sup>th</sup>  
12

A T A B L E shewing the Semidiurnal Arch, or Time of Sun-setting, when the Sun hath North Declination; and the Seminocturnal Arch, or Time of Sun-rising, when the Sun hath South Declination.

The Degrees of Latitude.

Sun's Decl.	13		14		15		16		17		18	
	H	M	H	M	H	M	H	M	H	M	H	M
0	06	00	06	00	06	00	06	00	06	00	06	00
1	06	01	06	01	06	01	06	01	06	01	06	01
2	06	02	06	02	06	02	06	02	06	02	06	02
3	06	03	06	03	06	03	06	03	06	04	06	04
4	06	04	06	04	06	04	06	05	06	05	06	05
Degrees of Declination.	5	06	05	06	05	06	05	06	06	06	06	06
	6	06	06	06	06	06	06	06	07	06	07	06
	7	06	06	06	07	06	07	06	08	06	09	06
	8	06	07	06	08	06	09	06	09	06	10	06
	9	06	08	06	09	06	10	06	10	06	11	06
	10	06	09	06	10	06	11	06	12	06	12	06
	11	06	10	06	11	06	12	06	13	06	13	06
	12	06	11	06	12	06	13	06	14	06	15	06
	13	06	12	06	13	06	14	06	15	06	16	06
	14	06	13	06	14	06	15	06	16	06	17	06
15	06	14	06	15	06	16	06	18	06	19	06	20
16	06	15	06	16	06	18	06	19	06	20	06	21
17	06	16	06	17	06	19	06	20	06	21	06	22
18	06	17	06	19	06	20	06	21	06	24	06	24
19	06	18	06	20	06	21	06	23	06	24	06	26
20	06	19	06	21	06	22	06	24	06	25	06	27
21	06	20	06	22	06	24	06	25	06	27	06	29
22	06	21	06	23	06	25	06	27	06	28	06	30
23	06	22	06	24	06	26	06	28	06	30	06	32
23-29	06	23	06	25	06	27	06	29	06	31	06	33

A TABLE shewing the Semidiurnal Arch, or Time of Sun-setting, when the Sun hath North Declination ; and the Seminocturnal Arch, or Time of Sun-rising, when the Sun hath South Declination.

The Degrees of Latitude .

Sun's Decli	19		20		21		22		23		24	
	H	M	H	M	H	M	H	M	H	M	H	M
0	06	00	06	00	06	00	06	00	06	00	06	00
1	06	01	06	01	06	01	06	02	06	02	06	02
2	06	03	06	03	06	03	06	03	06	03	06	03
3	06	04	06	04	06	05	06	05	06	05	06	05
4	06	05	06	06	06	06	06	06	06	07	06	07
5	06	07	06	07	06	08	06	08	06	09	06	09
6	06	08	06	09	06	09	06	10	06	10	06	11
7	06	10	06	10	06	11	06	11	06	12	06	13
8	06	11	06	12	06	12	06	13	06	14	06	14
9	06	13	06	13	06	14	06	15	06	15	06	16
10	06	14	06	15	06	16	06	16	06	17	06	18
11	06	15	06	16	06	17	06	18	06	19	06	20
12	06	17	06	18	06	19	06	20	06	21	06	22
13	06	18	06	19	06	20	06	21	06	23	06	24
14	06	20	06	21	06	22	06	23	06	24	06	25
15	06	21	06	22	06	24	06	25	06	26	06	27
16	06	23	06	24	06	25	06	27	06	28	06	29
17	06	24	06	25	06	27	06	28	06	30	06	31
18	06	26	06	27	06	29	06	30	06	32	06	33
19	06	27	06	29	06	30	06	32	06	34	06	35
20	06	28	06	30	06	32	06	34	06	36	06	37
21	06	30	06	32	06	34	06	36	06	37	06	39
22	06	31	06	33	06	35	06	37	06	39	06	41
23	06	33	06	35	06	37	06	39	06	41	06	43
23.29	06	34	06	36	06	38	06	40	06	42	06	44

A T A B L E shewing the Semidiurnal Arch, or Time of Sun-setting, when the Sun hath North Declination; and the Seminocturnal Arch, or Time of Sun-rising, when the Sun hath South Declination.

The Degrees of Latitude.

Sun's Decl <sup>n</sup>	25		26		27		28		29		30	
	H	M	H	M	H	M	H	M	H	M	H	M
0	06	00	06	00	06	00	06	00	06	00	06	00
1	06	02	06	02	06	02	06	02	06	02	06	02
2	06	04	06	04	06	04	06	04	06	04	06	05
3	06	06	06	06	06	06	06	06	06	07	06	07
4	06	07	06	08	06	08	06	09	06	09	06	09
<hr/>												
5	06	09	06	10	06	10	06	11	06	11	06	12
6	06	11	06	12	06	12	06	13	06	13	06	14
7	06	13	06	14	06	14	06	15	06	16	06	16
8	06	15	06	16	06	16	06	17	06	18	06	19
9	06	17	06	18	06	19	06	19	06	20	06	21
<hr/>												
10	06	19	06	20	06	21	06	22	06	23	06	23
11	06	21	06	22	06	23	06	24	06	25	06	26
12	06	23	06	24	06	25	06	26	06	27	06	28
13	06	25	06	26	06	27	06	28	06	29	06	31
14	06	27	06	28	06	29	06	30	06	32	06	33
<hr/>												
15	06	29	06	30	06	31	06	33	06	34	06	36
16	06	31	06	32	06	34	06	35	06	37	06	38
17	06	33	06	34	06	36	06	37	06	39	06	41
18	06	35	06	36	06	38	06	40	06	42	06	43
19	06	37	06	39	06	40	06	42	06	44	06	46
<hr/>												
20	06	39	06	41	06	43	06	45	06	47	06	48
21	06	41	06	43	06	45	06	47	06	49	06	51
22	06	43	06	45	06	48	06	50	06	52	06	54
23	06	46	06	48	06	50	06	52	06	54	06	57
23.29	06	47	06	49	06	51	06	53	06	55	06	58

A T A B L E shewing the Semidiurnal Arch, or Time of Sun-setting, when the Sun hath North Declination; and the Seminocturnal Arch, or Time of Sun-rising, when the Sun hath South Declination.

The Degrees of Latitude.

Sun's Decli	31		32		33		34		35		36		
	H	M	H	M	H	M	H	M	H	M	H	M	
0	06	00	06	00	06	00	06	00	06	00	06	00	
1	06	02	06	02	06	03	06	03	06	03	06	03	
2	06	05	06	05	06	05	06	05	06	06	06	06	
3	06	07	06	08	06	08	06	08	06	08	06	09	
4	06	10	06	10	06	10	06	11	06	11	06	12	
<hr/>													
Degrees of Declination.	5	06	12	06	13	06	13	06	14	06	14	06	15
	6	06	15	06	15	06	16	06	16	06	17	06	18
	7	06	17	06	18	06	18	06	19	06	20	06	20
	8	06	19	06	20	06	21	06	22	06	23	06	23
	9	06	22	06	23	06	24	06	25	06	25	06	26
	<hr/>												
	10	06	24	06	25	06	26	06	27	06	28	06	29
	11	06	27	06	28	06	29	06	30	06	31	06	32
	12	06	29	06	31	06	32	06	33	06	34	06	36
	13	06	32	06	33	06	34	06	36	06	37	06	39
	14	06	34	06	36	06	37	06	39	06	40	06	42
	<hr/>												
	15	06	37	06	39	06	40	06	42	06	43	06	45
	16	06	40	06	41	06	43	06	45	06	46	06	48
	17	06	42	06	44	06	46	06	48	06	49	06	51
18	06	45	06	47	06	49	06	51	06	53	06	55	
19	06	48	06	50	06	52	06	54	06	56	06	58	
<hr/>													
20	06	51	06	53	06	55	06	57	06	59	07	01	
21	06	53	06	56	06	58	07	00	07	02	07	05	
22	06	56	06	58	07	01	07	03	07	06	07	08	
23	06	59	07	01	07	04	07	06	07	09	07	12	
23-29	07	01	07	03	07	06	07	08	07	11	07	14	

A TABLE shewing the Semidiurnal Arch, or Time of Sun-setting, when the Sun hath North Declination; and the Seminocturnal Arch, or Time of Sun-rising, when the Sun hath South Declination.

The Degrees of Latitude.

Sun's Decl.	37		38		39		40		41		42	
	H	M	H	M	H	M	H	M	H	M	H	M
0	06	00	06	00	06	00	06	00	06	00	06	00
1	06	03	06	03	06	03	06	03	06	03	06	04
2	06	06	06	06	06	06	06	07	06	07	06	07
3	06	09	06	09	06	10	06	10	06	10	06	11
4	06	12	06	13	06	13	06	13	06	14	06	14
<hr/>												
5	06	15	06	16	06	16	06	17	06	17	06	18
6	06	18	06	19	06	20	06	20	06	21	06	22
7	06	21	06	22	06	23	06	24	06	25	06	25
8	06	24	06	25	06	26	06	27	06	28	06	29
9	06	27	06	28	06	29	06	31	06	32	06	33
<hr/>												
10	06	31	06	32	06	32	06	34	06	35	06	37
11	06	34	06	35	06	36	06	38	06	39	06	40
12	06	37	06	38	06	40	06	41	06	43	06	44
13	06	40	06	42	06	43	06	45	06	46	06	48
14	06	43	06	45	06	47	06	48	06	50	06	52
<hr/>												
15	06	47	06	48	06	50	06	52	06	54	06	56
16	06	50	06	52	06	54	06	56	06	58	07	00
17	06	53	06	55	06	57	07	00	07	02	07	04
18	06	57	06	59	07	01	07	03	07	06	07	08
19	07	00	07	02	07	05	07	07	07	10	07	12
<hr/>												
20	07	04	07	06	07	09	07	11	07	14	07	17
21	07	07	07	10	07	12	07	15	07	18	07	21
22	07	11	07	14	07	16	07	19	07	22	07	25
23	07	15	07	17	07	20	07	23	07	27	07	30
23-29	07	17	07	19	07	22	07	25	07	29	07	32

A TABLE shewing the Semidiurnal Arch, or Time of Sun-setting, when the Sun hath North Declination; and the Seminocturnal Arch, or Time of Sun-rising, when the Sun hath South Declination.

The Degrees of Latitude.

Sun's Decli.	43		44		45		46		47		48	
	H	M	H	M	H	M	H	M	H	M	H	M
0	06	00	06	00	06	00	06	00	06	00	06	00
1	06	04	06	04	06	04	06	04	06	04	06	04
2	06	07	06	08	06	08	06	08	06	09	06	09
3	06	11	06	12	06	12	06	12	06	13	06	13
4	06	15	06	5	06	16	06	17	06	17	06	18
5	06	19	06	19	06	20	06	21	06	22	06	22
6	09	22	06	23	06	24	06	25	06	26	06	27
7	06	26	06	27	06	28	06	29	06	30	06	31
8	06	30	06	31	06	32	06	33	06	35	06	36
9	06	34	06	35	06	36	06	38	06	39	06	41
10	06	38	06	39	06	41	06	42	06	43	06	45
11	06	42	06	43	06	45	06	46	06	48	06	50
12	06	46	06	47	06	49	06	51	06	53	06	55
13	06	50	06	52	06	53	06	55	06	57	06	59
14	06	54	06	56	06	58	07	00	07	02	07	04
15	06	58	07	00	07	02	07	04	07	07	07	09
16	07	02	07	04	07	07	07	09	07	12	07	14
17	07	06	07	09	07	11	07	14	07	17	07	19
18	07	11	07	13	07	16	07	19	07	22	07	25
19	07	15	07	18	07	21	07	24	07	27	07	30
20	07	19	07	22	07	25	07	29	07	32	07	35
21	07	24	07	27	07	30	07	34	07	37	07	41
22	07	28	07	31	07	35	07	39	07	43	07	47
23	07	33	07	36	07	40	02	44	07	48	07	53
23.29	07	36	07	39	07	43	07	47	07	51	07	56

A T A B L E shewing the Semidiurnal Arch, or Time of Sun-setting, when the Sun hath North Declination; and the Seminocturnal Arch, or Time of Sun-rising, when the Sun hath South Declination.

The Degrees of Latitude.

Sun's Decl.	49		50		51		52		53		54	
	H	M	H	M	H	M	H	M	H	M	H	M
0	06	00	06	00	06	00	06	00	06	00	06	00
1	06	05	06	05	06	05	06	05	06	05	06	06
2	06	09	06	10	06	10	06	10	06	11	06	11
3	06	14	06	14	06	15	06	15	06	16	06	17
4	06	18	06	19	06	20	06	21	06	21	06	22
5	06	23	06	24	06	25	06	26	06	27	06	28
6	06	28	06	29	06	30	06	31	06	32	06	33
7	06	32	06	34	06	35	06	36	06	38	06	39
8	06	37	06	39	06	40	06	41	06	43	06	45
9	06	42	06	44	06	45	06	47	06	49	06	50
10	06	47	06	49	06	50	06	52	06	54	06	56
11	06	52	06	54	06	56	06	58	07	00	07	02
12	06	57	06	59	07	01	07	03	07	06	07	08
13	07	02	07	04	07	06	07	09	07	11	07	14
14	07	07	07	09	07	12	07	14	07	17	07	20
15	07	12	07	14	07	17	07	20	07	23	07	27
16	07	17	07	20	07	23	07	26	07	29	07	33
17	07	22	07	25	07	29	07	32	07	36	07	40
18	07	28	07	31	07	35	07	38	07	42	07	46
19	07	33	07	37	07	41	07	45	07	49	07	52
20	07	39	07	43	07	47	07	51	07	56	08	00
21	07	45	07	49	07	53	07	58	08	03	08	08
22	07	51	07	55	08	00	08	05	08	10	08	15
23	07	57	08	02	08	06	08	12	08	17	08	23
23.29	08	00	08	05	08	10	08	16	08	21	08	27



A TABLE shewing the Semidiurnal Arch, or Time of Sun-setting, when the Sun hath North Declination; and the Seminocturnal Arch, or Time of Sun rising, when the Sun hath South Declination.

The Degrees of Latitude.

Sun's Decl.	55		56		57		58		59		60	
	H	M	H	M	H	M	H	M	H	M	H	M
0	06	00	06	00	06	00	06	00	06	00	06	00
1	06	06	06	06	06	06	06	06	06	07	06	07
2	06	11	06	12	06	12	06	13	06	13	06	14
3	06	17	06	18	06	19	06	19	06	20	06	21
4	06	23	06	24	06	25	06	26	06	27	06	28
5	06	29	07	30	06	31	06	32	06	33	06	35
6	06	35	07	36	06	37	06	39	06	40	06	42
7	06	40	07	42	06	44	06	45	06	47	06	49
8	06	46	07	48	06	50	06	52	06	54	06	56
9	06	52	07	54	06	56	06	59	07	01	07	04
10	06	58	07	00	07	03	07	06	07	08	07	11
11	07	04	07	07	07	10	07	13	07	16	07	19
12	07	11	07	13	07	16	07	20	07	23	07	26
13	07	17	07	20	07	23	07	27	07	30	07	34
14	07	23	07	27	07	30	07	34	07	38	07	42
15	07	30	07	34	07	38	07	42	07	46	07	51
16	07	37	07	41	07	45	07	49	07	54	07	59
17	07	44	07	48	07	52	07	57	08	03	08	08
18	07	51	07	55	08	00	08	05	08	11	08	17
19	07	58	08	03	08	08	08	14	08	20	08	26
20	08	05	08	11	08	16	08	22	08	29	08	36
21	08	13	08	19	08	25	08	32	08	39	08	47
22	08	21	08	27	08	34	08	41	08	49	08	58
23	08	29	08	32	08	43	08	51	09	00	09	09
23.29	08	33	08	41	08	48	08	56	09	05	09	16

# The USE of the foregoing TABLES of Semidiurnal and Seminocturnal Arches.

To find the Time of the Sun's Rising and Setting, and the Length of the Day, and Night, by these Tables.

**FIRST**, seek the Sun's Declination in the Tables of Declination for the Day proposed; with which enter the Tables of Semidiurnal and Seminocturnal Arches; finding the Latitude of the Place in the Head of the Table, and the Degrees of the Sun's Declination in the first Column on the Left-hand; and in the common Angle of Meeting is the Semidiurnal Arch, if the Sun hath North Declination; but it's Seminocturnal Arch, if the Sun hath South Declination.

**Example 1.** For Illustration hereof, let it be required to find the Time of the Sun's Rising and Setting, the Length of the Day and Night, for the 4th Day of May, 1778, in Latitude 46 Degrees North.

At which Time the Sun's Declination is 16 deg. 3 min. North; with which enter the Table, as is before declared, and the Semidiurnal Arch is 7 Hours 9 Min. the true Time of Sun-setting; whose Complement to 12 Hours is the Seminocturnal Arch, or the Time of the Sun-rising, and is 4 Hours 51 Minutes; double the Semidiurnal Arch you have the Length of the Day; double the Seminocturnal Arch, the Aggregate is the Length of the Night. See the Work following.

H. M.

12 : 00

The Semidiurnal Arch, or Time of Sun-setting - 07 : 09

The Complement to 12 Hours is - - - - 04 : 51

The Seminocturnal Arch, or Time of Sun-rising, in Latitude 46 Degrees North, is 4 Hours 51 Minutes.

The

	H. M.
The Semi-diurnal Arch double - - - - -	{ 07 : 09
	{ 07 : 09

The Length of the Day, May 4, 1786, is	14 : 18
--	---------

The Semi-nocturnal Arch doubled - - - - -	{ 04 : 51
	{ 04 : 51

The Length of the Night, May 4, 1786, is ——— 09 : 42

Example 2. But when the Sun hath 16 deg. 03 min. South Declination, in the Latitude of 46 deg. North ; then the Day Arch will become the Night Arch, and the Night-Arch will become the Day-Arch.

As, on Nov, 6, 1783, the Sun hath 16 deg. 02 min. South Declination ; then the Time of the Sun's Rising is 7 Hours 9 Minutes, his Setting 4 Hours 51 Minutes ; the Length of the Day 9 Hours 42 Minutes, and the Length of the Night 14 Hours 18 Minutes.

Example 3. Let it be required to find the Time of the Sun's Rising and Setting, with the Length of the Day and Night from the 26th of December, 1787, in Latitude 53 deg North ; at which Time the Sun's Declination is 23 deg. 23 min. South.

	H. M.
	12 : 60
The Seminocturnal Arch, or Time of Sun-rising —	08 : 20

The Complement to 12 Hours is - - - - -	03 : 40
---	---------

And is the Semidiurnal Arch, or Time of Sun-setting.

The Semidiurnal Arch doubled - - - - -	{ 03 : 40
	{ 03 : 40

The Length of the Day, December 26, 1777, is	07 : 20
--	---------

The Seminocturnal Arch doubled - - - - -	{ 08 : 20
	{ 08 : 20

The Length of the Night, Dec. 26, 1787, —	16 : 40
---	---------

The

These Tables will serve as well in South Latitude as in North, with this Alteration only: When in South Latitude, then use South Declination there, as you do North Declination here in North Latitude.

For then these Tables shew the Semidiurnal Arch, or the Time of Sun-rising, when the Sun hath South Declination; and the Seminocturnal Arch, or the Time of Sun-setting, when the Sun hath North Declination.

*Example 4.* Let it be required to find the Time of the Sun's Rising and Setting, with the Length of the Day and Night, for the 4th of May, 1787, in Latitude 46 Degrees South.

At which Time the Sun's Declination is 16 Degrees 00 Minutes North; with which enter the Table, and the Seminocturnal Arch is 7 Hours 9 Minutes the Time of Sun rising; whose Complement 12 Hours is the Semidiurnal Arch, or Time of Sun-setting, which is at 51 Minutes past 5 of the Clock.

	H.	M.
The Seminocturnal doubled	07	09
The Length of the Night, May, 4, 1787, in	07	09
Latitude 46 Degrees South	14	18
The Semidiurnal Arch doubled	04	51
The Length of the Day, the 4th of May,	04	51
1787. Latitude 46 Degrees South	09	42

*Example 5.* Let it be required to find the Time of the Sun's Rising and Setting, with the Length of the Day and Night, for the 11th of December, 1783 in Latitude 53 Degrees South. At which Time the Sun's Declination is 23 deg. 3 min. South; with which enter the Table of Semidiurnal Arches, &c. and you will find as follows.

H. M.

	H. M.
	12 : 00
The Semidiurnal Arch, or Time of Sun-setting	08 : 17
The Seminocturnal Arch, or Time of Sun-rising	03 : 43
The Length of the Day	16 : 34
Length of the Night, December 11, 1783	} 07 : 26
Latitude 53 Degrees South	

*To find the Time of a Star's Rising or Setting.*

**B**Y these Tables the Time of the Rising and Setting of all the Stars in the Heavens (whose Declination do not exceed the Sun's greatest Declination,) in any Latitude that the Tables contain, and at any Time of the Year, is found in this Manner.

If the Star hath North Declination, and you are in North Latitude, look for the Latitude in the Head of the Table, the Declination on the Left-hand, and in the common Angle of Meeting is the Star's Semiapparent Arch, or half the Time of the Star's Continuance above the Horizon, in that Latitude; or the space of Time which that Star takes in ascending from the Horizon to the Meridian, on the East-side; likewise descending from the Meridian, to the Horizon, on the West-side of the Meridian. Now, if you subtract these Hours and Minutes from the Time of the Star's coming to the Meridian, the Remainder will be the Time of the Star's Rising: And if you add, the Sum will be the true Time of the Star's Setting.

*Example 6.* Let it be required to find the Time of the Rising and Setting of the *Bull's Eye*, November the 30th in the Latitude of 52 Degrees North: The Declination of the Star is 16 deg. North; the 30th Day of November this Star cometh on the Meridian at 56 Minutes past 11 of the Clock at Night.

H. M.

	H. M.
The Time of the Star's Southing - - - - -	11 : 56
The Semi-apparent Arch, subtract - - - - -	07 : 26
	<hr/>
The Time of the Star's Rising in the Evening -	04 : 30
	<hr/>
Time of the Star's Setting in the Morning - -	07 : 22

Note 1. If the Sum of the Addition exceed 12 Hours, cast away 12 Hours; the Surplus is the Star's Setting.

2. And when you can't subtract, add 12 Hours to the Star's Southing, and then subtract: What remains is it's Rising.

Example 7. I desire to know the Time of the Rising and Setting of the Bull's Eye, the 30th Day of November, in the Latitude of 13 Degrees North: The Declination of the Bull's Eye 16 deg. North?

	H. M.
The Time of the Star's Southing - - - - -	11 : 56
The Semi-apparent Arch, subtract - - - - -	06 : 15
	<hr/>
The Time of his Rising in the Evening - - -	05 : 41
	<hr/>
The Time of his Setting in the Morning - -	06 : 11

If the Star hath South Declination, and you are in North Latitude, look (as before) the Latitude in the Head of the Table, the Declination on the Left side, and in the common Angle of Meeting is the Star's Semi-depressed Arch: which subtract from 12 Hours, the Remainder is the Star's Semi-apparent Arch, or half the Time that the Star doth continue above the Horizon in that Latitude: Therefore subtract those Hours and Minutes from the Time of the Star's coming to the Meridian, adding 12 Hours to the Star's Southing, if otherwise Subtraction cannot be made, the Remainder will be the Time of the Star's Rising; and if you add, the Sum will be the Time of the Star's Setting.

Example

*Example 8.* Let it be required to find the Time of the Rising and Setting of the Bright Star in the *Great Dog's Mouth*, the 15th Day of *November*, in the Latitude of 50 deg. North. The Declination of the *Great Dog's Mouth*, is 16d. 24m. South, and its Southing is 3 Hours, 12 min. in the Morning, the 25th of *November*.

	H.	M.
The Time of the Star's Southing is	-	03 : 12
To it add	-	12 : 00
The Sum is	-	15 : 12
The Semi-depressed Arch, by the Table is	-	07 : 22
Which subtra& from	-	12 : 00
The Remainder is the Semi-apparant Arch	-	04 : 38
Time of Southing with 12 Hours added is	-	15 - 12
The Semi-apparant Arch subtract	-	04 : 38
Time of the Star's Rising in the Evening	-	10 : 34
Time of the Star's Setting from Noon, or 50 } min. past 7 in the Morning	-	19 : 50

*Example 9.* I desire to know the Rising and Setting of the *Great Dog*, the 15th of *November*, in the Latitude of 30 Degrees North.

	H.	M.
Time of Southing with 12 Hours added	-	15 : 12
The Semi-depressed Arch, by the Table, is	-	6 : 39
Subtra& from	-	12 : 00
Remainder of the Semi-apparant Arch	-	5 : 21
Time of Southing, with 12 Hours added, is	-	15 : 12
Subtract, gives the Time of the Star's rising in } the Evening	-	9 : 51
Added, gives the Star's setting in the Morning, } when 12 Hours are subtracted	-	8 : 33

*In South Latitude, to know the Time of Rising and Setting of the Stars.*

Proceed with those Stars that hath North Delination in South Latitude, as with Stars that have South Declination in North Latitude.

H

*Example.*

*Example 10.* Let it be required to find the Time of the Rising and Setting of the *Bull's Eye* the 18th Day of *November*, in the Latitude of 42 Degrees South.

The Declination of this Star is 16 Deg. 00 min North: the 18th Day of *November*, this Star cometh upon the Meridian at 47 min. past 12 in the Morning.

	H. M.
The Semi-depress'd Arch, by the Table is ———	07 : 08
Which subtract from ———	12 : 00
<hr/>	
The Remainder is the Semi-apparent Arch ———	04 : 52
<hr/>	
The Time of the Star's Northing is ———	12 : 47
The Semi-apparent Arch, subtract ———	04 : 52
<hr/>	
Time of the Star's Rising in the Evening ———	07 : 47
<hr/>	
Time of the Star's Setting in the Morning ———	05 : 47

In like Manner the rising and Setting of any Star (whose Declination exceedeth not the Sun's greatest) may be found in any Latitude, from the Equinoctial to 60 Degrees, either North or South.

## A S T R O N O M I C T A B L E S,

*Shewing the Points of the Compass, the Sun and Stars Rise and Set upon.*

Being of excellent Use for readily finding the Variation of the Compass; and may be performed by an ordinary Meridian Compass, but more exactly by an Azimuth Compass.

Fitting all Parts of the World, where the Pole is not elevated above 60 Deg. either North or South.



**Latitude 0 Degree.**

North Dec.	Dec.	South Dec.
⊙ ri   ⊙ set	d. m.	⊙ ri   ⊙ set
East West	0.00	East West
1	2.49	1
2	5.37	2
3	8.26	3
ebn wbn	11.15	e b s w b s
1	14.04	1
2	16.52	2
3	19.41	3
enc wnw	22.30	e s e w s w

**Latitude 1 Degree**

North Dec.	Dec.	South Dec.
⊙ ri   ⊙ set	d. m.	⊙ ri   ⊙ set
East West	0.00	East West
1	2.49	1
2	5.37	2
3	8.26	3
ebn wbn	11.15	e b s w b s
1	14.04	1
2	16.52	2
3	19.41	3
enewnw	22.30	e s e w s w

**Latitude 2 Degrees.**

North Dec.	Dec.	South Dec.
⊙ ri   ⊙ set	d. m.	⊙ ri   ⊙ set
East West	0.00	East West
1	2.49	1
2	5.37	2
3	8.26	3
ebn wbn	11.15	e b s w b s
1	14.04	1
2	16.52	2
3	19.40	3
enc wnw	22.29	e s e w s w

**Latitude 3 Degrees.**

North Dec.	Dec.	South Dec.
⊙ ri   ⊙ set	d. m.	⊙ ri   ⊙ set
East West	0.00	East West
1	2.49	1
2	5.37	2
3	8.25	3
ebn wbn	11.14	e b s w b s
1	14.03	1
2	16.51	2
3	19.39	3
encwnw	22.27	e s e w s w

## Latitude 4 Degrees.

North Dec.	Dec.	South Dec.
☉ ri   ☉ set	d. m.	☉ ri   ☉ set
East West	0.00	East West
1	2.48	1
2	5.37	2
3	8.25	3
ebn wbn	11.14	ebs wbs
1	14.02	1
2	16.50	2
3	19.38	3
enc wnW	22.25	esc wsw

## Latitude 5 Degrees.

North Dec.	Dec.	South Dec.
☉ ri   ☉ set	d. m.	☉ ri   ☉ set
East West	0.00	East West.
1	2.48	1
2	5.36	2
3	8.24	3
ebn wbn	11.12	ebs wbs
1	13.01	1
2	16.49	2
3	19.36	3
enc wnW	22.23	esc wsw

## Latitude 6 Degrees.

North Dec.	Dec.	South Dec.
☉ ri   ☉ set	d. m.	☉ ri   ☉ set
East West	0.00	East West
1	2.48	1
2	5.36	2
3	8.23	3
ebn wbn	11.11	ebs wbs
1	13.59	1
2	16.47	2
3	19.32	3
enc wnW	22.21	esc wsw

## Latitude 7 Degrees.

North Dec.	Dec.	South Dec.
☉ ri   ☉ set	d. m.	☉ ri   ☉ set
East West	0.00	East West
1	2.48	1
2	5.35	2
3	8.22	3
ebn wbn	11.09	ebs wbs
1	13.57	1
2	16.45	2
3	19.32	3
enc wnW	22.19	esc wsw

**Latitude 8 Degree.**

North Dec.		Dec.	South Dec.	
⊙ ri   ⊙ fet		d. m.	⊙ ri   ⊙ fet	
East West		0.00	East West	
1		2.47	1	
2		5.35	2	
3		8.21	3	
cbn wbn		11.08	ebs wbs	
1		13.55	1	
2		16.42	2	
3		19.29	3	
ene wnw		21.16	ese wsw	

**Latitude 9 Degree**

North Dec.		Dec.	South Dec.	
⊙ ri   ⊙ fet		d. m.	⊙ ri   ⊙ fet	
East West		0.00	East West	
1		2.47	1	
2		5.33	2	
3		8.20	3	
cbn wbn		11.06	ebs wbs	
1		13.53	1	
2		16.40	2	
3		19.26	3	
ene wnw		22.12	ese wsw	

**Latitude 10 Degrees.**

North Dec.		Dec.	South Dec.	
⊙ ri   ⊙ fet		d. m.	⊙ ri   ⊙ fet	
East West		0.00	East West	
1		2.46	1	
2		5.32	2	
3		8.18	3	
cbn wbn		11.04	ebs wbs	
1		13.50	1	
2		16.37	2	
3		19.22	3	
ene wnw		21.08	ese wsw	

**Latitude 11 Degrees.**

North Dec.		Dec.	South Dec.	
⊙ ri   ⊙ fet		d. m.	⊙ ri   ⊙ fet	
East West		0.00	East West	
1		2.46	1	
2		5.31	2	
3		8.17	3	
cbn wbn		11.03	ebs wbs	
1		13.48	1	
2		16.33	2	
3		19.18	3	
ene wnw		22.03	ese wsw	

## Latitude 12 Degrees.

North Dec.		Dec.	South Dec.	
☉ ri   ☉ fet	d. m.	☉ ri   ☉ fet		
East West	0.00	East West		
1	2.45	1		
2	5.30	2		
3	8.15	3		
ebn wbn	11.00	ebs wbs		
1	13.45	1		
2	16.30	2		
3	19.14	3		
ene wnw	21.58	ese wsw		

## Latitude 13 Degrees

North Dec.		Dec.	South Dec.	
☉ ri   ☉ fet	d. m.	☉ ri   ☉ fet		
East West	0.00	East West		
1	2.45	1		
2	5.29	2		
3	8.13	3		
ebn wbn	10.57	ebs wbs		
1	13.42	1		
2	16.26	2		
3	19.10	3		
ene wnw	21.52	ese wsw		

## Latitude 14 Degrees.

North Dec.		Dec.	South Dec.	
☉ ri   ☉ fet	d. m.	☉ ri   ☉ fet		
East West	0.00	East West		
1	2.44	1		
2	5.28	2		
3	8.11	3		
ebn wbn	10.55	ebs wbs		
1	13.38	1		
2	16.22	2		
3	19.04	3		
ene wnw	21.47	ese wsw		

## Latitude 15 Degrees.

North Dec.		Dec.	South Dec.	
☉ ri   ☉ fet	d. m.	☉ ri   ☉ fet		
East West	0.00	East West		
1	2.43	1		
2	5.26	2		
3	8.09	3		
ebn wbn	10.52	ebs wbs		
1	13.35	1		
2	16.17	2		
3	18.59	3		
ene wnw	21.41	ese wsw		

**Latitude 16 Degrees.**

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		2.42	1	
2		5.25	2	
3		8.06	3	
ebn wbn		10.49	ebs wbs	
1		13.31	1	
2		16.12	2	
3		18.53	3	
enewnw		21.34	esewsw	

**Latitude 17 Degrees.**

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	m. p.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		2.42	1	
2		5.23	2	
3		8.04	3	
ebn wbn		10.46	ebs wbs	
1		13.29	1	
2		16.08	2	
3		18.47	3	
enewnw		21.27	esewsw	

**Latitude 18 Degrees.**

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		2.41	1	
2		5.21	2	
3		8.01	3	
ebn wbn		10.42	ebs wbs	
1		13.22	1	
2		16.02	2	
3		18.40	3	
enewnw		21.20	esewsw	

**Latitude 19 Degrees.**

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		2.40	1	
2		5.19	2	
3		7.58	3	
ebn wbn		10.38	eb wbs	
1		13.17	1	
2		15.56	2	
3		18.34	3	
enewnw		21.27	esewsw	

## Latitude 20 Degrees.

North Dec.		Dec.	South Dec.	
☉ ri	☉ set	d. m.	☉ ri	☉ set
East	West	0.00	East	West
1		2.38	1	
2		5.17	2	
3		7.55	3	
ebn wbn		10.34	eb s wbs	
1		13.12	1	
2		15.49	2	
3		18.27	3	
cne wnw		21.04	cse wsw	

## Latitude 21 Degrees.

North Dec.		Dec.	South Dec.	
☉ ri	☉ set	d. m.	☉ ri	☉ set
East	West	0.00	East	West
1		2.38	1	
2		5.15	2	
3		7.52	3	
ebn wbn		10.30	eb s wbs	
1		13.07	1	
2		15.43	2	
3		18.20	3	
cne wnw		20.55	cse wsw	
1		23.32	1	

## Latitude 22 Degrees.

North Dec.		Dec.	South Dec.	
☉ ri	☉ set	d. m.	☉ ri	☉ set
East	West	0.00	East	West
1		2.37	1	
2		5.13	2	
3		7.49	3	
ebn wbn		10.25	eb s wbs	
1		13.01	1	
2		15.37	2	
3		18.12	3	
cne wnw		20.46	cse wsw	
1		23.21	1	

## Latitude 23 Degrees.

North Dec.		Dec.	South Dec.	
☉ ri	☉ set	d. m.	☉ ri	☉ set
East	West	0.00	East	West
1		2.36	1	
2		5.11	2	
3		7.46	3	
ebn wbn		10.21	eb s wbs	
1		12.56	1	
2		15.31	2	
3		18.03	3	
cne wnw		20.37	cse wsw	
1		23.11	1	

**Latitude 24 Degrees.**

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		2.34	1	
2		5.08	2	
3		7.42	3	
ebn wbn		10.16	ebs wbs	
1		12.50	1	
2		15.23	2	
3		17.55	3	
ene wnw		20.27	ese wsw	
1		23.00	1	

**Latitude 25 Degrees.**

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		2.33	1	
2		5.05	2	
3		7.38	3	
ebn wbn		10.11	ebs wbs	
1		12.43	1	
2		15.15	2	
3		17.46	3	
ene wnw		20.17	ese wsw	
1		20.48	1	

**Latitude 26 Degrees.**

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		2.34	1	
2		5.03	2	
3		7.35	3	
ebn wbn		10.06	ebs wbs	
1		12.36	1	
2		15.08	2	
3		17.37	3	
ene wnw		20.06	ese wsw	
1		22.36	1	

**Latitude 27 Degrees.**

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		2.30	1	
2		5.00	2	
3		7.31	3	
ebn wbn		10.01	eb wbs	
1		12.30	1	
2		15.00	2	
3		17.28	3	
ene wnw		19.55	ese wsw	
1		22.23	1	

## Latitude 28 Degrees.

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		2.29	1	
2		4.58	2	
3		7.27	3	
ebn wbn		9.55	ebs wbs	
1		12.23	1	
2		14.51	2	
3		17.18	3	
ene wnw		19.44	ese wsw	
1		22.11	1	

## Latitude 29 Degrees.

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		2.28	1	
2		4.55	2	
3		7.22	3	
ebn wbn		9.50	ebs wbs	
1		12.16	1	
2		14.43	2	
3		17.08	3	
ene wnw		19.32	ese wsw	
1		21.58	1	

## Latitude 30 Degrees.

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		2.27	1	
2		4.52	2	
3		7.18	3	
ebn wbn		9.44	ebs wbs	
1		12.09	1	
2		14.34	2	
3		16.57	3	
ene wnw		19.20	ese wsw	
1		21.44	1	

## Latitude 31 Degrees.

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		2.25	1	
2		4.50	2	
3		7.13	3	
ebn wbn		9.38	ebs wbs	
1		12.01	1	
2		14.25	2	
3		16.47	3	
ene wnw		19.08	ese wsw	
1		21.30	1	



Latitude 32 Degrees.

North Dec.	Dec.	South Dec.
⊙ ri   ⊙ set	d. m.	⊙ ri   ⊙ set
East West	0.00	East West
1	2.33	1
2	4.46	2
3	7.08	3
ebn wbn	9.31	ebs wbs
1	11.54	1
2	14.15	2
3	16.36	3
enc wnw	18.55	esc wsw
1	21.16	1

Latitude 33 Degrees.

North Dec.	Dec.	South Dec.
⊙ ri   ⊙ set	d. m.	⊙ ri   ⊙ set
East West	0.00	East West
1	2.22	1
2	4.43	2
3	7.04	3
ebn wbn	9.25	ebs wbs
1	11.46	1
2	14.06	2
3	16.24	3
enc wnw	18.43	esc wsw
1	21.01	1
2	23.17	2

Latitude 34 Degrees.

North Dec.	Dec.	South Dec.
⊙ ri   ⊙ set	d. m.	⊙ ri   ⊙ set
East West	0.00	East West
1	2.20	1
2	4.40	2
3	6.59	3
ebn wbn	9.18	ebs wbs
1	11.38	1
2	13.56	2
3	16.13	3
enc wnw	18.29	esc wsw
1	20.46	1
2	23.00	2

Latitude 35 Degrees.

North Dec.	Dec.	South Dec.
⊙ ri   ⊙ set	d. m.	⊙ ri   ⊙ set
East West	0.00	East West
1	2.18	1
2	4.37	2
3	6.54	3
ebn wbn	9.12	ebs wbs
1	11.29	1
2	13.46	2
3	16.02	3
enc wnw	18.16	esc wsw
1	20.30	1
2	22.43	2

## Latitude 36 Degrees.

North Dec.		Decl.	South Dec.	
Ori	Offset	d. m.	Ori	Offset
East	West	0.00	East	West
1		2.16	1	
2		4.33	2	
3		6.49	3	
ebn wbn		9.05	ebn wbn	
1		11.20	1	
2		13.35	2	
3		15.49	3	
ene wnw		18.02	ene wnw	
1		20.15	1	
2		22.25	2	

## Latitude 37 Degrees.

North Dec.		Decl.	South Dec.	
Ori	Offset	d. m.	Ori	Offset
East	West	0.00	East	West
1		2.15	1	
2		4.30	2	
3		6.43	3	
ebn wbn		8.58	ebn wbn	
1		11.12	1	
2		13.25	2	
3		15.36	3	
ene wnw		17.47	ene wnw	
1		19.58	1	
2		22.07	2	

## Latitude 38 Degrees.

North Dec.		Decl.	South Dec.	
Ori	Offset	d. m.	Ori	Offset
East	West	0.00	East	West
1		2.13	1	
2		4.26	2	
3		6.38	3	
ebn wbn		8.50	ebn wbn	
1		11.03	1	
2		13.14	2	
3		15.23	3	
ene wnw		17.32	ene wnw	
1		19.41	1	
2		21.49	2	

## Latitude 39 Degrees.

North Dec.		Decl.	South Dec.	
Ori	Offset	d. m.	Ori	Offset
East	West	0.00	East	West
1		2.11	1	
2		4.22	2	
3		6.32	3	
ebn wbn		8.43	ebn wbn	
1		10.53	1	
2		13.03	2	
3		15.10	3	
ene wnw		17.17	ene wnw	
1		19.25	1	
2		21.30	2	
3		23.32	3	

## Latitude 40 Degrees.

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		2.09	1	
2		4.19	2	
3		6.27	3	
ebn wbn		8.36	eb s wbs	
1		10.43	1	
2		12.51	2	
3		14.57	3	
ene wnw		17.02	ese wsw	
1		19.07	1	
2		21.10	2	
3		23.11	3	

## Latitude 41 Degrees.

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		2.07	1	
2		4.15	2	
3		6.22	3	
ebn wbn		8.28	eb s wbs	
1		10.34	1	
2		12.40	2	
3		14.44	3	
ene wnw		16.47	ese wsw	
1		18.50	1	
2		20.51	2	
3		22.50	3	

## Latitude 42 Degrees.

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		2.05	1	
2		4.11	2	
3		6.16	3	
ebn wbn		8.20	eb s wbs	
1		10.24	1	
2		12.28	2	
3		14.30	3	
ene wnw		16.31	ese wsw	
1		18.32	1	
2		20.31	2	
3		22.27	3	

## Latitude 43 Degrees.

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		2.03	1	
2		4.07	2	
3		6.10	3	
ebn wbn		8.12	eb s wbs	
1		10.14	1	
2		12.16	2	
3		14.16	3	
ene wnw		16.15	ese wsw	
1		18.14	1	
2		20.10	2	
3		22.05	3	

## Latitude 44 Degrees.

North Dec.		Decl.	South Dec.	
⊙ ri   ⊙ fet	d. m.		⊙ ri   ⊙ fet	
East West	0.00		East West	
1	2.01		1	
2	4.03		2	
3	6.04		3	
e b n w b n	8.04	e b s w b s		
1	10.04		1	
2	12.03		2	
3	14.01		3	
e n e w n w	15.59	e s e w s w		
1	17.54		1	
2	19.50		2	
3	21.42		3	
n e b e n w b w	23.34	s e b e s w b w		

## Latitude 45 Degrees.

North Dec.		Decl.	South Dec.	
⊙ ri   ⊙ fet	d. m.		⊙ ri   ⊙ fet	
East West	0.00		East West	
1	2.00		1	
2	3.59		2	
3	5.57		3	
e b n w b n	7.56	e b s w b s		
1	9.54		1	
2	11.51		2	
3	13.46		3	
e n e w n w	15.42	e s e w s w		
1	17.36		1	
2	19.28		2	
3	21.19		3	
n e b e n w b w	23.08	s e b e s w b w		

## Latitude 46 Degrees.

North Dec.		Decl.	South Dec.	
⊙ ri   ⊙ fet	d. m.		⊙ ri   ⊙ fet	
East West	0.00		East West	
1	1.58		1	
2	3.55		2	
3	5.51		3	
e b n w b n	7.47	e b s w b s		
1	9.43		1	
2	11.38		2	
3	13.32		3	
e n e w n w	15.25	e s e w s w		
1	17.17		1	
2	19.07		2	
3	20.55		3	
n e b e n w b w	22.42	s e b e s w b w		

## Latitude 47 Degrees.

North Dec.		Decl.	South Dec.	
⊙ ri   ⊙ fet	d. m.		⊙ ri   ⊙ fet	
East West	0.00		East West	
1	1.55		1	
2	3.50		2	
3	5.45		3	
e b n w b n	7.39	e b s w b s		
1	9.33		1	
2	11.25		2	
3	13.17		3	
e n e w n w	15.07	e s e w s w		
1	16.57		1	
2	18.45		2	
3	20.31		3	
n e b e n w b w	22.16	s e b e s w b w		

Latitude 48 Degrees.

North Dec.	Dec.	South Dec.
⊙ ri   ⊙ set	d. m.	⊙ ri   ⊙ set
East West	0.00	East West
1	1.53	1
2	3.46	2
3	5.38	3
ebn wbn	7.30	eb s wbs
2	9.22	1
1	11.12	2
3	13.01	3
ene wnw	14.50	ese wsw
1	16.38	1
2	18.24	2
3	20.07	3
nebenwbw	21.49	sebe swbw
1	23.29	1

Latitude 49 Degrees.

North Dec.	Dec.	South Dec.
⊙ ri   ⊙ set	d. m.	⊙ ri   ⊙ set
East West	0.00	East West
1	1.51	1
2	3.42	2
3	5.31	3
ebn wbn	7.22	eb s wbs
1	9.10	1
2	10.59	2
3	12.46	3
ene wnw	14.32	ese wsw
1	16.17	1
2	18.01	2
3	19.42	3
nebenwbw	21.22	sebe swbw
1	23.01	1

Latitude 50 Degrees.

North Dec.	Dec.	South Dec.
⊙ ri   ⊙ set	d. m.	⊙ ri   ⊙ set
East West	0.00	East West
1	1.48	1
2	3.37	2
3	5.25	3
ebn wbn	7.12	eb s wbs
1	8.59	1
2	10.46	2
3	12.30	3
ene wnw	14.14	ese wsw
1	15.57	1
2	17.39	2
3	19.18	3
nebenwbw	20.55	sebe swbw
1	22.31	1

Latitude 51 Degrees.

North Dec.	Dec.	South Dec.
⊙ ri   ⊙ set	d. m.	⊙ ri   ⊙ set
East West	0.00	East West
1	1.46	1
2	3.33	2
3	5.18	3
ebn wbn	7.04	eb s wbs
1	8.48	1
2	10.32	2
3	12.14	3
ene wnw	13.56	ese wsw
1	15.36	1
2	17.16	2
3	18.52	3
nebenwbw	20.28	sebe swbw
1	22.01	1
	23.32	2

## Latitude 52 Degrees.

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0 00	East	West
1		1.44	1	
2		3.27	2	
3		5.11	3	
e b n w b n		6.54	e b s w b s	
2		8.36	1	
1		10.18	2	
3		11.58	3	
e n e w n w		13.37	e s e w s w	
1		15.16	1	
2		16.52	2	
3		18.27	3	
nebenwbw		20.00	sebe swbw	
1		21.31	1	
2		23.00		

## Latitude 53 Degrees.

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		1.42	1	
2		3.23	2	
3		5.04	3	
e b n w b n		6.44	e b s w b s	
1		8.25	1	
2		10.04	2	
3		11.42	3	
e n e w n w		13.19	e s e w s w	
1		14.55	1	
2		16.29	2	
3		18.01	3	
nebenwbw		19.32	sebe swbw	
1		21.01	1	
2		22.27	2	

## Latitude 54 Degrees.

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		1.39	1	
2		3.18	2	
3		5.57	3	
e b n w b n		6.35	e b s w b s	
1		8.13	1	
2		9.50	2	
3		11.23	3	
e n e w n w		13.00	e s e w s w	
1		14.33	1	
2		16.05	2	
3		17.35	3	
nebenwbw		19.05	sebe swbw	
1		20.30	1	
2		21.54	2	
3		23.15	3	

## Latitude 55 Degrees.

North Dec.		Dec.	South Dec.	
⊙ ri	⊙ fet	d. m.	⊙ ri	⊙ fet
East	West	0.00	East	West
1		1.37	1	
2		3.13	2	
3		4.49	3	
e b n w b n		6.25	e b s w b s	
1		8.01	1	
2		9.35	2	
3		11.08	3	
e n e w n w		12.41	e s e w s w	
1		14.12	1	
2		15.42	2	
3		17.09	3	
nebenwbw		18.35	sebe swbw	
1		19.59	1	
2		21.21	2	
3		23.30	3	

Latitude 56 Degrees.

North Dec.		Dec.	South Dec.	
◊ ri	◊ set	d. m.	◊ ri	◊ set
East	West	0.00	East	West
1		1.34	1	
2		3.09	2	
3		4.42	3	
ebn wbn		6.16	ebs wbs	
1		7.49	1	
2		9.21	2	
3		10.51	3	
ene wnw		12.22	ese wsw	
1		13.50	1	
2		15.18	2	
3		16.42	3	
benwbw		18.06	sebe swbw	
1		19.28	1	
2		20.47	2	
3		22.03	3	
ne nw		23.18	se sw	

Latitude 57 Degrees

North Dec.		Dec.	South Dec.	
◊ ri	◊ set	d. m.	◊ ri	◊ set
East	West	0.00	East	West
1		1.32	1	
2		3.04	2	
3		4.35	3	
ebn wbn		6.06	ebs wbs	
1		7.36	1	
2		9.06	2	
3		10.34	3	
ene wnw		12.01	ese wsw	
1		13.28	1	
2		14.53	2	
3		16.16	3	
nebenwbw		17.37	sebe swbw	
1		18.56	1	
2		20.13	2	
3		21.27	3	
ne nw		22.39	se sw	

Latitude 58 Degrees.

East West		0.00	East West	
1		1.30	1	
2		2.59	2	
3		4.28	3	
ebn wbn		5.56	ebs wbs	
1		7.24	1	
2		8.51	2	
3		10.17	3	
ene wnw		11.42	ese wsw	
1		13.06	1	
2		14.28	2	
3		15.48	3	
nebenwbw		17.07	sebe swbw	
1		18.24	1	
2		19.39	2	
3		20.51	3	
ne nw		22.00	se sw	
1		23.08	1	

Latitude 59 Degrees.

East West		0.00	East West	
1		1.27	1	
2		2.54	2	
3		4.20	3	
ebn wbn		5.46	ebs wbs	
1		7.11	1	
2		8.36	2	
3		10.00	3	
ene wnw		11.22	ese wsw	
1		12.44	1	
2		14.03	2	
3		15.21	3	
nebenwbw		16.37	sebeswbw	
1		17.52	1	
2		19.04	2	
3		20.14	3	
ne nw		21.22	se sw	
1		22.26	1	
2		23.27	2	

## Latitude 60 Degrees.

North Declination.			South Declination.		
☉ rise	D. M.	☉ set	☉ rise	D. M.	☉ set
East	0.00	West	East	0.00	West
1	1.25	1	1	1.25	1
2	2.49	2	2	2.49	2
3	4.12	3	3	4.12	3
e by n	5.36	w by n	e by s	5.36	w by s
1	6.59	1	1	6.59	1
2	8.21	2	2	8.21	2
3	9.42	3	3	9.42	3
e n e	11.02	w n w	e s e	11.02	w s w
1	12.21	1	1	12.21	1
2	13.38	2	2	13.38	2
3	14.53	3	3	14.53	3
n e by e	16.08	n w by w	s e by e	16.08	s w by s
1	17.20	1	1	17.20	1
2	18.30	2	2	18.30	2
3	19.38	3	3	19.38	3
n e	20.42	n w	s e	20.42	s w
1	21.45	1	1	21.45	1
2	22.45	2	2	22.44	2

The Description and Use of the foregoing TABLES.

1. **T**HES E Tables of the Points of the Compass, (for the Sun, or any Star whose Declination exceeds not 23 deg. 29m.) begin at Latitude 0 deg. and proceed orderly to 60 deg. (being some four, some two Tables, in one Page) and sixty-one in all.

2. In each Table are five Columns; the middlemost contains the Degrees of Declination, either North or South; those two on each Side of it, marked ☉ rise ☉ set (under North or South Declination) stand for Sun-rising and Sun-setting.

3. The



3. The first and second Columns (under *North Declination*) as also the fourth and fifth Columns (under *South Declination*) contain the Points, and each Quarter of a Point of the Compass, of both Rising and Setting: Thus, *East, West*, under which is 1, 2, 3; that is *East* or *West* 1 Quarter, 2 Quarters, 3 Quarters, *Northerly* or *Southerly*; then *E. by N. W. by N.* under which is 1, 2, 3; that is *E. by N.* or *W. by N.* 1 Quarter, 2 Quarters *Northerly*, &c.

These Tables are ready Helps for finding the Variation of the Compass with Ease, and sufficient Exactness, as is evident from the following Explanation.

*To find the Point of the Compass that the Sun riseth or setteth with, at any Time of the Year.*

**FIRST**, seek the Sun's Declination in the Table of Declination for the Time proposed; with which enter the foregoing Table, finding the Latitude in the Head of the Table, and the Declination in the third Column; against which, on the Left-hand, if it be North Declination, but on the Right-hand if it be South Declination, is the Point of the Compass that the Sun rises or sets at, according to the Titles at the Head of the Table.

*Note*, These Tables shew the true Points of the Sun's Rising and Setting; so that you may readily know at any Time, seeing the Sun rise or set, the Variation by an ordinary Meridian Compass.

There are some Compasses not touched so well as they ought to be; others in Time will grow weak, or lose their magnetic Virtue.

Now by these foregoing Tables you may very readily discover any of these Defects.

It may indeed be objected, they cannot see the Sun by an ordinary Meridian Compass, so near as is required

To this I answer, it's as easy to set the Sun by the Compass, as to steer a Ship by it; for expert Seamen can set the Sun, or Headland, to near a Quarter of a Point by their Hand, (but with Sights much nearer the Truth.) The Posture to observe in such Case, I advise, is thus:

Set the Compass about two Feet high, and directing your Hand towards the Sun, note what Point, Half Point, or Quarter Point, the Sun riseth or setteth on; then in that Table belonging to the Latitude, see whether the Sun riseth or sets that Day upon the same Point, found by Observation; if they agree, there is no Variation; but if they do not agree, the Compass is not true, or there is Variation; and the Variation is so much, as is the Difference between the Observation and the Table.

*Example 1.* Admit in Latitude 30 Degrees North, the Sun having 9 Degrees 44 Minutes North Declination; I observe the Sun that Day to rise upon the E.N.E. Point of the Compass. I demand the Variation.

In the Head of the foregoing Tables, look for the Latitude 30 Degrees; and in the third Column for 9 deg. 44 min. North Declination; and against it (under ☉ rise) is E. by N. which sheweth that there is one Point Variation. For it appears by the Table, that the E. N. E. Point on the Compass is the true E. by N. Point; and the E. by N. (as it is upon the Compass) is the true E. Point; the East Point is the true E. by S. the S.E. is the S.E. by S. and the South is the S. by W. the W. is the W. by N. and

This plainly appears by the *Rectifier*, if you bring the E. by N. on the outward Circle, right against the E.N.E. on the inward Circle.

Now suppose we were to observe the Sun at his setting, in the Latitude of 30 deg. with Declination 9 deg. 44 min. North as abovesaid, we should find the Sun to set exactly at West by the Compass, although in the Morning

Morning we did find the Sun to rise at E. N. E. I know this will appear a Contradiction to some; but if you cast your Eye upon the *Rectifier*, you may see it's a certain Truth.

*Example 2.* In Latitude 37 deg. North, the Sun's Declination 8 deg. 58 min. North, I observe the Sun to rise E. by N. by the Compass; I demand the Variation

In the Table that belongs to 37 deg. against 8 deg. 58 min. North Declination, and under ☉ rise is E. by N. which sheweth there is no Variation, because the Observation agrees with the Tables.

*Note,* If the Declination for the Day proposed be not the same with the Declination in the Tables, then have Regard to the nearest, allowing for the Difference, by the Rule of Proportion.

*Example 3.* In the Latitude 37 deg. North, suppose the Sun's Declination 10 deg. 15 min. North, I demand the Point of the Compass the Sun then riseth upon?

In the Tables nearest to 10 deg. 15 min. is 11 deg. 12 min. against which the Sun riseth E. by N. a Quarter N. and sets W. by N. a Quarter N. but in the Tables for 37 deg Latitude, the Declination proposed is near about the middle, between 8 deg. 58 min. and 11 deg. 12 min. Therefore the Sun riseth E. by N. half a Quarter N. and setteth W. by N. half a Quarter N.

Understand the like in any Case, let the Declination be what it will, and in any other Latitude.

*Example 4.* Admit in Latitude 38 deg. 20m. North, and Declination 19d. 50m. South: The Sun riseth upon the ESE. Point of the Compass; I demand the Variation?

In the Table for Latitude 38 deg. and against 19 deg. 41 min. (the nearest to the given Declination) is E S.E. a Quarter S. which sheweth that there is a Quarter of a Point Variation. For the E.S.E. Point is E.S.E. a quarter S. and the North Point is N. a quarter E. For, if you bring ESE. a quarter S. on the outward Circle of the *Rectifier* right against E.S.E. on the inward Circle, then S.S.W. on the  
Compass

Compass is SSW. a quarter W. and SE. is SE. a quarter S. and E. is E. a quarter S. And so for any other Point, Half point, or Quarter point, by casting your Eye upon the *Rectifier*.

*Note,* These Tables shew the true Points of Rising and Setting, and the outward Circle on the *Rectifier* doth the same; but the Compass, when it differeth from the Tables, shews a false Point; and the inward Circle on the *Rectifier* doth the same.

*Example 5.* Admit in Latitude 47d. 24m. North, the Declination 15d. 2m. South, the Sun's rising E. by S. by the Compass; I demand the Variation.

By the Tables the Sun should rise ESE. therefore there is one Point Variation: For if you bring ESE. on the outward Circle of the *Rectifier*, over against the E. by S. on the inward Circle, then the N. by W. on the Compass is the true North point; the NW. is the NW. by N. and the S. by E. is the true South Point.

By this Time I suppose the Reader able to discover how much the Variation is, and how to reckon it without any Geometric Demonstration, or Arithmetic Calculation.

*Note,* If you have any odd minutes of Latitude, go to that Table nearest the Latitude you are in.

I come now to resolve a Question which some are puzzled with; and that is this:

*Quest.* If the Sun rise at ENE. by any Compass in any Latitude, should not he set the same Day at WNW. by the same Compass, and in the same Latitude?

*Answer.* If there be no Variation he will; but if there be Variation, he will not. The Reason is evident by the *Rectifier*.

By these Tables you may know upon what Point of the Compass any of the Stars rise and set in any Latitude the Tables contain, either North or South, if the Declination doth not exceed the Sun's greatest Declination.

*Example 6.* Let it be required to find the Points of the Compass the *Bull's Eye* rises and sets with, in the Latitude of 50 Degrees North.

The Declination of this Star is 16 Deg. North; in the Table that belongs to 50d. against 16 Deg. North Declination, the true Point of Rising is E.N.E. a Quarter N. and the true Point of Setting W.N.W. a Quarter N.

Understand the like for any other Star, whose Declination doth not exceed the Sun's greatest Declination.

### *The Use of the RECTIFIER.*

**T**HIS Instrument, as before described, (in Page 93, 94, and 95) containeth two Circles, or Compasses, one within the other; but as it is made of Wood, the one moves upon the other, and by it the Compass, when it varies, may be rectified as follows:

Bring the true Point of Rising or Setting (as the Table sheweth) on the outward or under Compass, right against the false Point of Rising or Setting (as your Compass sheweth) on the inward or upper Compass; then will the under Compass rectify the upper.

*Example 7.* Admit in Latitude 45d. N. the Sun's Declination being 7d. 56m. South, the Sun setting upon the W. by N. Point of the Compass, I demand the Variation?

The Sun, if there be no Variation, will set at W. by S. and rise at E. by S. as appears from the Table; therefore it is plain that there are two Points Variation.

Bring the W. by S. Point on the outward Compass, right against the W. by N. Point on the inward Compass; then the Points upon the outward Compass explain the Points that are upon the inward; so that according to the foregoing Observation, the N.N.E. Point on the Compass is the true North: The North is the true N.N.W. the W. by N. is the true W. by S. the S.E. by E. is the true E. by S. And so for any other Point of the Compass by only looking on the *Rectifier*.

And thus you may rectify the Compass, without reckoning which Way the Variation is, either Eastward or Westward: The *Rectifier* doing it so plain, that you can't be mistaken.

A TABLE of Amplitudes, fitting all Places  
from the Equator, to 60 Degrees of Latitude  
either North or South.

The Degrees of Latitude.

*Copy the  
amplitude  
from  
this  
table.*

Sun's Decl.	1		2		3		4		5		6	
	D	M	D	M	D	M	D	M	D	M	D	M
0	00	00	00	00	00	00	00	00	00	00	00	00
1	01	00	01	00	01	00	01	00	01	00	01	00
2	02	00	02	00	02	00	02	00	02	00	02	00
3	03	00	03	00	03	00	03	00	03	00	03	01
4	04	00	04	00	04	00	04	00	04	01	04	01
5	05	00	05	00	05	00	05	00	05	01	05	01
6	06	00	06	00	06	00	06	01	06	01	06	02
7	07	00	07	00	07	00	07	01	07	01	07	02
8	08	00	08	00	08	01	08	01	08	02	08	02
9	09	00	09	00	09	01	09	01	09	02	09	02
10	10	00	10	00	10	01	10	01	10	02	10	03
11	11	00	11	00	11	01	11	01	11	02	11	03
12	12	00	12	00	12	01	12	01	12	03	12	04
13	13	00	13	00	13	01	13	01	13	03	13	04
14	14	00	14	00	14	01	14	02	14	03	14	04
15	15	00	15	00	15	01	15	02	15	03	15	05
16	16	00	16	01	16	01	16	02	16	04	16	05
17	17	00	17	01	17	01	17	02	17	04	17	05
18	18	00	18	01	18	01	18	02	18	04	18	06
19	19	00	19	01	19	01	19	02	19	04	19	06
20	20	00	20	01	20	02	20	03	20	05	20	06
21	21	00	21	01	21	02	21	03	21	05	21	07
22	22	00	22	01	22	02	22	03	22	05	22	07
23	23	00	23	01	23	02	23	03	23	05	23	07
23.29	23	22	23	30	23	31	23	33	23	35	23	39

Degrees of Declination.

A TABLE of Amplitudes, fitting all Places from the Equator, to 60 Degrees of Latitude either North or South.

The Degrees of Latitude.

Sun's Decli	7		8		9		10		11		12	
	D	M	D	M	D	M	D	M	D	M	D	M
0	00	00	00	00	00	00	00	00	00	00	00	00
1	01	00	01	00	01	00	01	01	01	01	01	01
2	02	01	02	01	02	01	02	02	02	02	02	03
3	03	01	03	01	03	01	03	03	03	03	03	04
4	04	02	04	02	04	02	04	04	04	04	04	05
5	05	02	05	02	05	03	05	05	05	05	05	07
6	06	02	06	03	06	04	06	06	06	06	06	08
7	07	03	07	04	07	05	07	07	07	08	07	09
8	08	03	08	04	08	06	08	08	08	09	08	11
9	09	04	09	05	09	06	09	09	09	10	09	12
10	10	04	10	06	10	07	10	10	10	11	10	13
11	11	05	11	06	11	08	11	11	11	13	11	15
12	12	05	12	07	12	09	12	12	12	14	12	16
13	13	06	13	08	13	09	13	13	13	15	13	17
14	14	06	14	08	14	10	14	14	14	16	14	19
15	15	07	15	09	15	11	15	15	15	17	15	20
16	16	07	16	10	16	12	16	16	16	19	16	22
17	17	08	17	10	17	13	17	17	17	20	17	23
18	18	08	18	11	18	14	18	18	18	21	18	25
19	19	09	19	12	19	15	19	19	19	22	19	26
20	20	09	20	12	20	16	20	20	20	24	20	28
21	21	10	21	13	21	17	21	21	21	25	21	29
22	22	10	22	13	22	18	22	22	22	27	22	31
23	23	11	23	14	23	19	23	23	23	28	23	33
23.29	23	40	23	15	23	50	23	54	23	59	24	05

A T A B L E of Amplitudes, fitting all Places  
from the Equator, to 60 Degrees of Latitude  
either North or South.

The Degrees of Latitude.

Sun's Decli	13		14		15		16		17		18	
	D	M	D	M	D	M	D	M	D	M	D	M
0	00	00	00	00	00	00	00	00	00	00	00	00
1	01	02	01	20	01	02	01	02	01	02	01	03
2	02	03	02	22	02	04	02	05	02	05	02	06
3	03	05	03	24	03	06	03	07	03	08	03	09
4	04	06	04	26	04	08	04	10	04	11	04	12
5	05	08	05	09	05	10	05	12	05	13	05	15
6	06	10	06	11	06	13	06	15	06	17	06	19
7	07	11	07	13	07	15	07	17	07	19	07	22
8	08	13	08	15	08	17	08	19	08	22	08	25
9	09	14	09	17	09	19	09	21	09	25	09	28
10	10	16	10	19	10	21	10	24	10	28	10	31
11	11	17	11	20	11	23	11	27	11	30	11	34
12	12	19	12	22	12	25	12	29	12	33	12	38
13	13	20	13	24	13	27	13	32	13	36	13	41
14	14	22	14	26	14	30	14	34	14	39	14	44
15	15	24	15	28	15	32	15	37	15	42	15	47
16	16	26	16	30	16	35	16	40	16	45	16	51
17	17	28	17	32	17	37	17	42	17	48	17	54
18	18	30	18	34	18	39	18	45	18	51	18	58
19	19	31	19	36	19	42	19	48	19	54	20	01
20	20	33	20	38	20	44	20	51	20	57	21	04
21	21	35	21	40	21	46	21	53	21	00	22	08
22	22	37	22	43	22	49	22	56	22	04	23	12
23	23	39	23	45	23	51	23	58	24	06	24	15
23-29	24	41	24	46	24	54	24	01	24	09	24	18



A TABLE of Amplitudes, fitting all Places from the Equator, to 60 Degrees of Latitude either North or South.

The Degrees of Latitude.

Sun's Decli	19		20		21		22		23		24	
	D	M	D	M	D	M	D	M	D	M	D	M
0	00	00	00	00	00	00	00	00	00	00	00	00
1	01	03	01	04	01	04	01	05	01	05	01	06
2	02	07	02	08	02	08	02	09	02	10	02	12
3	03	10	03	12	03	13	03	14	03	15	03	37
4	04	14	04	16	04	17	04	19	04	21	04	23
5	05	17	05	19	05	22	05	23	05	26	05	28
6	06	21	06	23	06	26	06	28	06	31	06	34
7	07	24	07	27	07	30	07	33	07	37	07	40
8	08	28	08	31	08	34	08	38	08	42	08	46
9	09	31	09	35	09	39	09	43	09	47	09	51
10	10	35	10	39	10	43	10	48	10	52	10	57
11	11	38	11	43	11	48	11	53	11	58	12	03
12	12	42	12	47	12	52	12	58	13	03	13	09
13	13	46	13	51	13	57	14	03	14	09	14	15
14	14	50	14	55	15	01	15	08	15	14	15	21
15	15	53	16	00	16	06	16	13	16	20	16	27
16	16	57	17	04	17	11	17	18	17	26	17	34
17	18	01	18	08	18	15	18	23	18	31	18	40
18	19	05	19	12	19	20	19	28	19	37	19	46
19	20	08	20	16	20	24	20	33	20	42	20	52
20	21	12	21	20	21	29	21	39	21	49	21	59
21	22	16	22	25	22	34	22	44	22	55	23	07
22	23	20	23	29	23	39	23	50	24	01	24	12
23	24	24	24	34	24	44	24	55	25	07	25	19
23.29	24	58	25	08	25	18	25	29	25	41	25	54

A TABLE of Amplitudes, fitting all Places from the Equator, to 60 Degrees of Latitude either North or South.

The Degrees of Latitude.

Sun's Decl <sup>n</sup>	25		26		27		28		29		30	
	D	M	D	M	D	M	D	M	D	M	D	M
0	00	00	00	00	00	00	00	00	00	00	00	00
1	01	06	01	07	01	08	01	08	01	09	01	09
2	02	12	02	13	02	15	02	16	02	17	02	18
3	03	18	03	20	03	22	03	24	03	26	03	28
4	04	25	04	27	04	29	04	32	04	34	04	37
5	05	31	05	33	05	37	05	40	05	43	05	46
6	06	37	06	41	06	44	06	48	06	52	06	56
7	07	43	07	48	07	51	07	56	08	01	08	06
8	08	50	08	54	08	59	09	04	09	09	09	15
9	09	56	10	01	10	06	10	12	10	18	10	24
10	11	03	11	08	11	14	11	21	11	27	11	34
11	12	09	12	15	12	21	12	28	12	36	12	44
12	13	16	13	23	13	30	13	37	13	45	13	53
13	14	22	14	30	14	37	14	45	14	54	15	03
14	15	29	15	37	15	45	15	54	16	00	16	12
15	16	35	16	44	16	53	17	03	17	12	17	23
16	17	42	17	51	18	01	18	11	18	21	18	32
17	18	49	18	59	19	09	19	20	19	31	19	43
18	19	56	20	06	20	17	20	29	20	41	20	54
19	21	02	21	13	21	25	21	38	21	51	22	05
20	22	10	22	22	22	34	22	48	23	02	23	16
21	23	18	23	30	23	43	23	57	24	12	24	27
22	24	24	24	37	24	51	25	06	25	22	25	38
23	25	32	25	46	26	01	26	16	26	32	26	49
24	26	08	26	23	26	37	26	52	27	08	27	25

A T A B L E of Amplitudes, fitting all Places  
from the Equator, to 60 Degrees of Latitude  
either North or South.

The Degrees of Latitude.

Sun's Decl.	31		32		33		34		35		36	
	D	M	D	M	D	M	D	M	D	M	D	M
0	00	00	00	00	00	00	00	00	00	00	00	00
1	01	10	01	10	01	11	01	12	01	13	01	14
2	02	19	02	21	02	23	02	25	02	27	02	29
3	03	30	03	33	03	35	03	38	03	40	03	43
4	04	40	04	43	04	46	04	50	04	53	04	57
5	05	50	05	54	05	57	06	02	06	06	06	11
6	07	00	07	05	07	09	07	15	07	20	07	25
7	08	11	08	16	08	21	08	27	08	33	08	40
8	09	21	09	27	09	33	09	39	09	46	09	54
9	10	31	10	38	10	45	10	52	11	10	11	08
10	11	41	11	48	11	55	12	03	12	12	12	21
11	12	52	13	00	13	09	13	18	13	28	13	39
12	14	02	14	11	14	21	14	32	14	43	14	54
13	15	13	15	23	15	33	15	44	15	56	16	09
14	16	22	16	33	16	45	16	57	17	10	17	24
15	17	34	17	46	17	58	18	11	18	25	18	40
16	18	44	18	57	19	11	19	25	19	40	19	55
17	19	56	20	10	20	24	20	39	20	55	21	11
18	21	07	21	21	21	36	21	53	22	10	22	27
19	22	19	22	34	22	50	23	07	23	25	23	44
20	23	31	23	47	24	04	24	22	24	41	25	00
21	24	43	25	00	25	18	25	37	25	56	26	17
22	25	55	26	13	26	32	26	52	27	13	27	35
23	27	07	27	26	27	46	28	07	28	29	28	52
23-29	27	43	28	03	28	23	28	45	29	05	29	32

Degrees of Declination.

A TABLE of Amplitudes, fitting all Places from the Equator, to 60 Degrees of Latitude either North or South.

The Degrees of Latitude.

Sun's Decl <sup>n</sup>	37		38		39		40		41		42	
	D	M	D	M	D	M	D	M	D	M	D	M
0	00	00	00	00	00	00	00	00	00	00	00	00
1	01	15	01	16	01	17	01	18	01	20	01	21
2	02	30	02	32	02	34	02	36	02	39	02	41
3	03	45	03	48	03	51	03	54	03	58	04	02
4	05	00	05	04	05	08	05	13	05	18	05	23
5	06	16	06	21	06	26	06	32	06	38	06	44
6	07	31	07	37	07	43	07	50	07	57	08	05
7	08	47	08	54	09	01	09	09	09	17	09	26
8	10	02	10	10	10	19	10	28	10	37	10	47
9	11	17	11	27	11	37	11	47	11	58	12	09
10	12	32	12	43	12	54	13	06	13	18	13	31
11	13	50	14	01	14	13	14	26	14	39	14	53
12	15	06	15	18	15	31	15	45	16	00	16	15
13	16	22	16	35	16	49	17	04	17	20	17	37
14	17	38	17	52	18	08	18	24	18	42	19	00
15	18	55	19	11	19	28	19	45	20	04	20	23
16	20	11	20	28	20	46	21	05	21	25	21	46
17	21	28	21	46	22	06	22	26	22	48	23	10
18	22	48	23	05	23	25	23	47	24	10	24	34
19	24	04	24	20	24	46	25	09	25	33	25	58
20	25	21	25	43	26	06	26	30	26	56	27	24
21	26	39	27	02	27	27	27	53	28	21	28	50
22	27	58	28	23	28	49	29	16	29	45	30	16
23	29	17	29	43	30	11	30	40	31	11	31	43
23-29	29	58	30	24	30	52	31	22	31	54	32	28

Degrees of Declination.

A TABLE of Amplitudes, fitting all Places from the Equator, to 60 Degrees of Latitude either North or South.

The Degrees of Latitude.

Sun's Decli	43		44		45		46		47		48	
	D	M	D	M	D	M	D	M	D	M	D	M
0	00	00	00	00	00	00	00	00	00	00	00	00
1	01	22	01	23	01	25	01	26	01	28	01	29
2	02	44	02	47	02	50	02	53	02	56	02	59
3	04	06	04	10	04	15	04	19	04	24	04	29
4	05	28	05	34	05	40	05	46	05	52	05	59
5	06	51	06	58	07	05	07	12	07	20	07	29
6	08	13	08	21	08	30	08	39	08	49	08	59
7	09	35	09	45	09	56	10	06	10	18	10	30
8	10	58	11	09	11	21	11	34	11	47	12	00
9	12	21	12	34	12	47	13	01	13	16	13	31
10	13	44	13	58	14	13	14	28	14	44	15	02
11	15	07	15	22	15	38	15	56	16	15	16	34
12	16	31	16	48	17	06	17	25	17	45	18	06
13	17	55	18	13	18	33	18	54	19	16	19	39
14	19	18	19	39	20	00	20	23	20	47	21	12
15	20	43	21	05	21	28	21	51	22	18	22	45
16	22	08	22	32	22	56	23	23	23	50	24	20
17	23	34	23	59	24	25	24	53	25	23	25	55
18	24	59	25	26	25	54	26	25	26	57	27	31
19	26	25	26	54	27	25	27	58	28	22	29	07
20	27	53	28	23	28	56	29	31	30	07	30	45
21	29	00	29	23	30	27	31	03	31	42	32	23
22	30	48	31	22	31	58	32	37	33	18	34	03
23	32	16	32	51	33	30	34	12	34	56	35	43
23-29	33	03	33	40	34	20	35	03	35	48	36	35

Degrees of Declination.

A TABLE of Amplitudes, -fitting all Places  
from the Equator, to 60 Degrees of Latitude  
either North or South.

The Degrees of Latitude.

Sun's Decl.	49		50		51		52		53		54	
	D	M	D	M	D	M	D	M	D	M	D	M
0	00	00	00	00	00	00	00	00	00	00	00	00
1	01	31	01	33	01	35	01	37	01	39	01	42
2	03	03	03	06	03	10	03	15	03	20	03	24
3	04	34	04	40	04	46	04	52	04	59	05	06
4	06	06	06	14	06	22	06	30	06	39	06	49
5	07	38	07	48	07	58	08	08	08	19	08	31
6	09	10	09	21	09	33	09	46	10	00	10	15
7	10	42	10	55	11	09	11	24	11	40	11	57
8	12	14	12	29	12	45	13	02	13	21	13	41
9	13	47	14	05	14	24	14	43	14	04	15	26
10	15	21	15	40	16	01	16	23	16	46	17	11
11	16	54	17	16	17	39	18	03	18	29	18	57
12	18	28	18	52	19	18	19	44	20	12	20	43
13	20	03	20	29	20	57	21	26	21	57	22	30
14	21	38	22	06	22	37	23	08	23	42	24	18
15	23	14	23	45	24	18	24	52	25	28	26	07
16	24	51	25	24	25	59	26	36	27	16	27	58
17	26	28	27	03	27	41	28	21	29	04	29	50
18	28	06	28	43	29	24	30	07	30	53	31	42
19	29	45	30	25	31	08	31	55	32	45	33	38
20	31	25	32	08	32	54	33	44	34	39	35	35
21	33	06	33	52	34	41	35	34	36	31	37	32
22	34	48	35	37	36	30	37	27	38	29	39	26
23	36	33	37	26	38	23	39	24	40	29	41	40
23.29	37	26	38	20	39	19	40	23	41	29	42	46

A TABLE of Amplitudes, fitting all Places from the Equator, to 60 Degrees of Latitude either North or South.

The Degrees of Latitude.

Sun's Decli	55		50		57		58		59		60	
	D	M	D	M	D	M	D	M	D	M	D	M
0	00	00	00	00	00	00	00	00	00	00	00	00
1	01	45	01	47	01	50	01	53	01	56	02	00
2	03	29	03	34	03	40	03	46	03	53	04	00
3	05	14	05	22	05	31	05	40	05	50	06	00
4	06	59	07	10	07	22	07	34	07	47	08	01
5	08	44	08	57	09	11	09	26	09	43	10	02
6	10	30	10	47	11	04	11	22	11	42	12	04
7	12	15	12	35	12	56	13	18	13	41	14	06
8	14	02	14	25	14	48	15	14	15	41	16	10
9	15	49	16	14	16	45	17	10	17	41	18	14
10	17	37	18	05	18	33	19	07	19	41	20	18
11	19	26	19	50	20	29	21	04	21	43	22	26
12	21	15	21	49	22	25	23	04	23	47	24	34
13	23	05	23	43	24	23	25	07	25	54	26	44
14	24	56	25	37	26	21	27	09	28	01	28	55
15	26	49	27	34	28	22	29	14	30	12	31	09
16	28	43	29	32	30	24	31	21	32	22	33	27
17	30	39	31	31	32	27	33	28	34	32	35	47
18	32	35	33	33	34	34	35	40	36	53	38	05
19	34	35	35	36	36	46	37	54	39	13	40	36
20	36	36	37	42	38	53	40	12	41	37	43	10
21	38	39	39	51	41	09	42	34	44	07	45	48
22	40	47	42	04	43	27	44	59	46	40	48	32
23	42	56	44	19	45	50	47	30	49	21	51	23
23.29	44	00	45	27	47	02	48	46	50	47	52	51

## The Use of the Tables of Amplitudes.

**T**HE Sun or Star's Amplitude is the Distance of the Rising or Setting of the Sun or Star from the East or West Point of the Horizon, in Degrees and Minutes, reckoned in the Horizon; either Northerly or Southerly.

*Note,* When the Sun or Star's have North Declination, they rise to the Northward of the East and set to the Northward of the West: But if their Declination be South, they rise to the Southward of the East, and set to the Southward of the West: And by these Tables the Amplitude is thus found, *viz.*

Look the Latitude in the Head of the Tables, the Declination in the first Column on the Left-Hand; and in the common Angle of Meeting is the Amplitude required.

*Example 1.* In the Latitude of 30 deg. the Sun's Declination being 7d. om. North, I demand the Amplitude?

*Ans.* The Amplitude is 8 deg. 6 min. For under Latitude 30d. in Page 140, and against Declination 7d. you will find 8d. 6m. which is the Amplitude from the East Northward at Sun-rising, and from the West Northward at Sun-setting. But if the Declination had been 7d. om. South in Latitude 30d. as aforesaid, then the Amplitude would have been 8d. 6m. from the East Southward at Sun-rising, and 8d. 6m. from the West-Southward at Sun-setting.

If there be any odd Minutes of Declination, take the Proportional Parts.

*Example 2.* In the Latitude of 42d. 30m. the Sun's Declination being 12d. 15m. I demand the Amplitude?

*Ans.* The Ampl. is 16d. 43m. found as follows: According to the former Directions, for the Lat. of 42d.

and Declin. being  $\left\{ \begin{array}{l} 12 \\ 13 \end{array} \right\}$  d. the Ampl. is  $\left\{ \begin{array}{l} 16d. 15m. \\ 17d. 37m. \end{array} \right.$

Subtract, and their Difference is  $\text{—————}$  1d. 22m.  
Then



Then say, as 1d. or 60m. is to 1d. 22m. or 82m. so is 15m. to 20m. found as hereunder :

If 60m. give ——— 82m. what shall 15m. ?

$$\begin{array}{r} 15 \\ \hline 410 \\ 82 \end{array}$$

610)12310(20m. Proportional Parts.  
030 Remainder.

Lat. 42d. and Declin. 12d. the Amplit. is 16d. : 15m.  
To it add the Proportional Parts above ——— 00d. : 20m.

Gives Amplitude for Declin. 12d 15m. to be 16d. : 35m.

Again, for Lat. 43d. { 12 } deg. Ampl. { 16d. : 31m.  
and Declin. ——— { 13 } ——— is ——— { 17d. : 55m.

Subtracted makes the Difference to be ——— 1d. : 24m.

Then say, As 60m. is to 1d. 24m. or 84m. so is 15m. to 21m. found as hereunder :

If 60m. give ——— 84m. what shall 15m.?

$$\begin{array}{r} 15 \\ \hline 420 \\ 84 \end{array}$$

610)12610(21min. Proportional Parts.  
06

00 Remainder.

Lat. 43d. and Declin. 12d. Amplitude is ——— D. M.  
To it add the Proportional Parts above ——— 16 : 31  
00 : 21

Gives for Declination 12d. 15m. the Amplitude is 16 : 52

Now because the given Latitude 42d. 30m. is in the middle between 42d. and 43d. therefore the Medium of the Amplitude before found, is the Amplitude required. and is thus :

Lat.  $\left\{ \begin{smallmatrix} 42 \\ 43 \end{smallmatrix} \right\}$  d. Decl. 12d. 15m. the Ampl. is  $\left\{ \begin{smallmatrix} 16d. : 35m. \\ 16d. : 52m. \end{smallmatrix} \right.$   
 Added together, is ————— 33d. : 27m.

The half is the Amplitude required ——— 16d. : 43m.  
 Thus may the Amplitude be found for any odd Minutes of Latitude or Declination, though the Table is calculated for whole Degrees only.

By this Table the Variation of the Compass is most readily found; for by the Azimuth or Amplitude Compass find the Sun or Star's Magnetic Amplitude, at their Rising or Setting; and their true Amplitude (according to the Latitude of the Place, and their Declination) by this Table; the Difference of these Amplitudes (when both are North or both South,) but their Sum (if one be North the other South) is the Variation of the Compass.

But by the *Rectifier* it is most easily done thus:

Bring the Magnetic Amplitude (on the upper or innermost Compass) right against the true Amplitude (on the lower or outermost Compass) then doth the North Point in the upper stand against the Variation in the lower; and the upper Compass is explained in all its Parts by the lower Compass.

*Example 1.* Suppose the Magnetic Amplitude at Sun-rising (found by the Azimuth or Amplitude Compass) be East Southerly 15d. 30m. and the true Amplitude (according to the Latitude of the Place, and the Declination of the Object observed) be East Southerly 26d. 45m. I demand the Variation of the Compass?

By the *Rectifier*.

Bring 15d. 30m. East Southerly on the upper Compass, against 26d. 45m. East Southerly on the lower Compass. Then doth the North Point on the first stand right against 11d. 15m. North Easterly on the latter; so that the Compass doth vary 11d. 15m. or one Point East.

*Example*

*Ex. 2.* { True } Ampl. { 07d. 00m. East Northerly.  
          { Magn. }        { 15d. 30m. East Southerly.  
I demand the Variation of the Compass?

*By the Rectifier.*

Bring 15d. 30m. East Southerly on the upper Compass, right against 7 deg. East Northerly on the lower Compass, then the North Point on the first stands against 22 deg. 30 min. on the last, North Westerly, that is two Points West Variation. In like Manner for any other; and thus the Variation is most readily found. This *RECTIFIER* is made of Wood

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The APPENDIX contains the Description of such INSTRUMENTS as are most useful in *Navigation*.

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*The Description and Use of the Fore-staff, or  
Cross-staff.*

THE *Fore-staff*, so called from the Posture of the Observer in using it, whose Face is towards the Object observed; though for the Sun it is so contrived (for preserving the Eye) to be used backward. It is called also a *Cross-Staff* from its Form; being a Square Staff with three or four Pieces of Wood across it, which are called Crosses, or Vanes.

The Staff is usually about 30 Inches, or 3 Feet long, and more than half an Inch Square, having four Sides, each graduated unequally like a Scale of Tangents. To each of them belongs a distinct Cross; though sometimes the shortest Cross is made to serve two Sides of the Staff; that is, the Breadth is for the Tenth-Cross, and the Length for the Thirty-Cross. Besides this, it hath two Crosses more; the longest is the Ninety-Cross, and the other is the Sixty-Cross. The four Crosses are thus to be understood, *viz.*

$$\left\{ \begin{array}{l} 10 \\ 30 \\ 60 \\ 90 \end{array} \right\} \text{ Cross belongs to that } \left\{ \begin{array}{l} 4 \\ 10 \\ 20 \\ 30 \end{array} \right\} \text{ Side beginning at } \text{and ending at } \left\{ \begin{array}{l} 10 \\ 30 \\ 60 \\ 90 \end{array} \right\}$$

The Figure of the *Fore-Staff*.



*The Use of the Fore-Staff.*

**B**EFORE the Invention of *Hadley's Quadrant* it was common and ordinary at Sea, to take the Meridian Altitude of the Sun or Star with this Instrument, and by it to find the Latitude the Ship is in.

To perform which observe the Precepts following :

1, *Note.*\* The 10, 30, 60, and 90 Crosss, are to be used according as the Meridian Altitude is more or less; that is, if less than 10d. use the 10 Crosss: if between 10 and 30d. use the 30 Crosss; if between 30 and 60d. the 60 Crosss, if more than 60, use the 90 Crosss.

2. Having considered which Crosss (according to the judged Altitude of the Object intended to be observed) is suitable, put it on the Staff, so that the flat Side of the Crosss may be towards the flat or Square End of the Staff; Then.

3. Hold the flat End of the Staff (as at A) to the Corner of your Eye; there let it rest upon your Eye Bone, as near the Corner of your Eye as you can, so it doth not hinder your Sight.

4. Then look to the upper End of your Crosss (as at C) for the Sun or Star, and at the lower End (at B) for the Horizon.

5. But if at the lower End of the Crosss you see all Sky and no Water, then draw the Crosss a little nearer to your Eye.

6. If on the contrary, you see all Water and no Sky, then slide the Crosss a little farther from you.

7. Then, if you see the Center of the Sun or Star at the upper End of the Crosss, and the Horizon at the lower End, the Crosss stands as it ought.

8. Wait till the Sun or Star be on the Meridian, making Observations often; and as the Sun or Star riseth, draw the Crosss a little nearer to your Eye.

9. If the Sun or Star be fallen, you will not see the Horizon, for the Water will hide it from you, and then Observing is over at that Time. Stir not the Crosss out of its Place, only see at what deg. &c. it resteth on that Side

of the Staff belonging to it; and the Degrees and Minutes cut by the Edge of the Cross is the Meridian Altitude or Complement thereof, according to the Word *Alt.* or *Comp.* on the Staff.

*How to use the Fore-Staff backwards.*

**T**HIS is only used with the Sun, and for this Purpose the Ten-Cross hath another Piece of Wood or Ivory put across it; so that the lower Edge of this Cross Piece lieth even with the middle of the Square Hole in the Ten-Cross, which also answers to the middle of the Thickness of the Staff.

There is also a Plate of Brass with a Hole in it, and so fitted, that it will slide on and fit the Ends of the 90, 60, or 30 Cross, these two Things added to the Fore-staff makes it fit for a backward Observation of the Sun, which is thus, *viz.*

1. According as the Meridian Altitude of the Sun, is more or less, so use the 90, 60, or 30 Cross; putting it on the Staff, the flat Side of it exactly even with the flat End of the Staff, there screw it fast; and at one end of the Cross, slip on the foresaid Brass Plate, so as to leave a slit Sight through it, near the lower End of the Cross.

2. Put the Ten-Cross (having a Cross-piece on it as aforesaid) on the Staff, the flat Side of it towards the other Cross at the Staffs End.

3. Turn your Back to the Sun, look through the Slit in the Brass, at the lower End of the Cross, for the Shadow at the upper End of it, lying on the Ten-Cross in the Line answering the middle of the Staff, and on each Side of the Staff.

4. At the same Time the Horizon should be seen (thru' the aforesaid Slit) to lie even with the Shadow on the middle Line, in the Ten-Cross; and at each End of it, on both Sides the Cross.

5. In looking through the Slit in the Brass, you must bring the Shadow upon the middle Line, and if instead of the Horizon you only see Water there, then draw the

Ten

Ten Crofs nearer, till the Shadow and Horizon agree or meet in the said middle Line.

6. On the contrary, looking as before, if instead of the Horizon you see Sky meet the Shadow on the middle Line; then put the Ten-Crofs from you, (till you see the Horizon and the Shadow meet together) on the middle Line.

7. Continue observing till the Sun be at the highest; and as the Sun riseth, you must draw the Ten-Crofs nearer, in order to keep the Horizon and Shadow together on the said Middle of it.

8. If the Sun be fallen (after you have continued observing as before directed) the Horizon will lie below the Shadow on the middle Line; then is the Observing finished at that Time: Stir not the Ten-Crofs out of its Place, for where it now stands (on that Side of the Staff belonging to the Crofs at the End of it) is the Sun's Meridian Altitude, or Complement thereof, as before in observing forward.

Thus I have shewed how to take an Observation by the Crofs-Staff both forward and backward. The next Thing in Order, will be to shew how to work it; and for that Purpose take Notice of the following Rules.

*To work an Observation.*

1. IF the Sun or Star hath North Declination, and be on the Meridian to the Southward of you, subtract the Declination from the Meridian Altitude; the Remainder is the Height of the Equinoctial or Complement of the Latitude North,

2. But if the Object observed hath South Declination, and be to the Southward of your Zenith, add; the Sum (if it exceed not 90 deg.) is the Height of the Equator, or Complement of the Latitude North: If the Sum exceeds 90 deg. subtract 90 from it; the Remainder is the Latitude South.

3. If the Object hath North Declination, and be on the Meridian to the Northward, add the Declination

to the Meridian Altitude ; the Sum if it exceed not 90d. is the Height of the Equator, or Complement of the Latitude South : But if it doth exceed 90 deg. subtract 90d. from the said Sum, the Remainder is the Latitude North.

4. If the Sun hath South Declination, and be to the Northward at Noon, subtract the Declination from his Meridian Altitude ; the Remainder is the Complement of the Latitude, South.

5. When the Sun hath no Declination, the Meridian Altitude is the Complement of the Latitude North, if he be South at Noon ; and on the contrary.

6. If the Sun be in the Zenith, and at the same Time he hath no Declination, you are then under the Equinoctial.

7. But if the Sun hath North or South Declination, and in the Zenith, the Declination is the Latitude you are in, North or South.

8. If you observe the Sun or any Star upon the Meridian beneath the Pole, add the Meridian Altitude to the Complement of the Sun or Star's Declination ; the Sum is the Height of the Pole, or Latitude of the Place.

These eight Rules are explained by the Examples following.

*Examples for working an Observation in North Latitude.*

*Example 1.* ADMIT at Sea I observe the Sun's Meridian Altitude to 42d. 20m. South, and at the same Time the Sun's Declination is 10d. 10m. North. I demand the Latitude I am in ?

	D.	M.
Meridian Altitude	42	: 20 South
Sun's Declination	10	: 10 North
		_____
The Complement of the Latitude	32	: 10
Subtract it from	90	: 00
		_____
The Latitude I am in, is	57	: 50

*Example*



*Example 2.* Being at Sea the 22d of May, Anno 1779, I find the Meridian Altitude to be 65d. 10m. South; I demand the Latitude?

	D.	M.
The Meridian Altitude —————	65	: 10 South
The Sun's Declination ————— subtracted	20	: 25 North
<hr/>		
The Complement of the Latitude —————	44	: 45
Subtract it from —————	90	: 00
<hr/>		
The Latitude I am in, is —————	45	: 15 North

*Example 3.* Being at Sea the 27th of November, Anno 1779, I find the Sun's Meridian Altitude to be 26 deg. 30 min. South; I demand the Latitude I am in?

	D.	M.
The Meridian Altitude —————	26	: 30 South
The Sun's Declination ————— add	21	: 11 South
<hr/>		
The Complement of the Latitude —————	47	: 41
Subtract it from —————	90	: 00
<hr/>		
The Latitude I am in, is —————	42	: 19 North

*Example 4.* At Sea the 25th of April, Anno 1782, I find the Sun's Meridian Altitude by Observation to be 58d. 45m. South; I demand the Latitude I am in?

	D.	M.
Meridian Altitude —————	58	: 45 South
The Declination —————	13	: 18 North
<hr/>		
The Complement of the Latitude —————	45	: 27
Subtract it from —————	90	: 00
<hr/>		
The Latitude I am in, is —————	44	: 33 North

*Example 5.* Admit the 12th Day of June, 1782; I find the Sun's Meridian Altitude by Observation to be 80 deg. 35 min. North; I demand the Latitude I am in?

The

D. M.

The Meridian Altitude \_\_\_\_\_ 80 : 35 North  
 Sun's Declination \_\_\_\_\_ add 23 : 11 North

The Sum is \_\_\_\_\_ 103 : 46  
 From it subtract \_\_\_\_\_ 90 : 00

The Latitude I am in, is \_\_\_\_\_ 13 : 46 North

*Example 6* Admit *August 22, 1784*, the Sun's Meridian Altitude was observed to be 85d. 15m. North; I demand the Latitude of that Place?

D. M.

The Meridian Altitude \_\_\_\_\_ 85 : 15 North  
 Sun's Declination \_\_\_\_\_ add 11 : 32 North

The Sum is \_\_\_\_\_ 96 : 47  
 From it subtract \_\_\_\_\_ 90 : 00

The Latitude of the Place is \_\_\_\_\_ 06 : 47 North

*Example 7.* Admit in a Ship at Sea, *June 19, 1784*, the Sun's Meridian Altitude is 66d. 46m. North; I demand the Latitude the Ship is in?

M. D.

The Meridional Altitude \_\_\_\_\_ 66 : 46 North  
 The Sun's Declination \_\_\_\_\_ add 23 : 28 North

Complement of the Latitude \_\_\_\_\_ 90 : 14  
 From it subtract \_\_\_\_\_ 90 : 00

The Ship is almost under the Equinoctial 00 : 14 North

*Examples to find the Latitude, by observing the Stars.*

*Example 8.* ADMIT I observe the *Bull's Eye* upon the Meridian, and find his Meridian Altitude to 50d. 30m. South; I demand the Latitude I am in?

The

	D.	M.	
The Declination of the <i>Bull's Eye</i> is	16	: 00	North
The Meridian Altitude of the Star	50	: 30	South
The Star's Declination	subtract	16 : 00	North
Complement of the Latitude, is	34	: 30	
Subtract it from	90	: 00	
The Latitude I am in, is	55	: 30	North

*Example 9.* Admit I observe the bright Star in the *Great Dog's Mouth*, and I find his Meridian Altitude to be 35d. 45m. South; I demand the Latitude I am in?

	D.	M.	
The Declin. of the <i>Great Dog's Mouth</i> is	16	: 24	South
The Meridian Altitude of the Star	35	: 45	South
The Star's Declination	add	16 : 24	South
The Height of the Equator is	52	: 09	
Subtract it from	90	: 00	
The Latitude I am in, is	37	: 51	North

*Example for working an Observation in South Latitude.*

*Example 10.* ADMIT the 10th Day of May, Anno 1778, I find the Sun's Meridian Altitude by Observation to be 62d. 00m. North; I demand the Latitude the Ship is in?

	D.	M.	
The Meridian Altitude	62	: 00	North
The Sun's Declination	add	17 : 43	North
The Complement of the Latitude is	79	: 43	
Subtract it from	90	: 00	
The Latitude the Ship is in, is	10	: 17	South

*Example 11.* Admit the 15th Day of January, Anno 1780, in Longitude 150d. East, I find the Meridian Altitude by Observation to be 38d. 45m. North; I demand the Latitude the Ship is in?

The

The Sun's Declination in the Meridian of *London*, for the 15th of *January* is 21d. 09m. the daily Difference at this Time is 11m. decreasing; therefore (in the Table of Proportion) in Page 20, you will find the Proportional Minutes to 5m, which add to the Declination in the Meridian of *London*, the Sum is 21d. 16m. South, the Sun's true Declination for the Longitude of 15d East

D. M.

The Meridian Altitude ————— 38 : 45 North

The Sun's Declination ————— subtract 21 : 14 South

Complement of the Latitude, is ————— 17 : 31

Subtract it from ————— 90 : 00

The Latitude the Ship is in, is ————— 72 : 29 South

*Example 12.* Admit the 12th Day of *July*, Anno 1783, I find the Sun's Meridian Altitude to be 66 deg. 52 min. North, I demand the Latitude? D. M.

The Meridian Altitude ————— 66 : 52 North

The Sun's Declination ————— add 22 : 00 North

Complement of the Latitude is ————— 88 : 52

Subtract it from ————— 20 : 00

Latitude required, is ————— or : 07 South

*Example 13.* A Ship at Sea, the Sun's Declination being 15d. 30m. South, and the Sun's Meridian Altitude 80d. 45m. South, I demand the Latitude the Ship is in?

*Ans.* The Latitude is 6d. 15m. South.

*Example 14.* The Sun's Declination being 11d. 14m. South, and his Meridian Altitude 79d. 38m. South; I demand the Latitude?

*Ans.* The Latitude is 0d. 52m. South.

*Note 1.* If you observe by the lower Part, Edge, or Limb of the Sun you must add to the Altitude taken, 16m. for the Sun's Semidiameter, and the Sum will be the true Altitude of the Sun's Center.

*Note 2.* If you observe by the upper Limb of the Sun, subtract 16m. the Remainder is the Altitude of the Sun's Center.

The Figure of the QUADRANT.



The Description and Use of the QUADRANT.

**T**HIS Instrument (called a Quadrant, first invented by our Countryman Capt. *Davis*, and thence called *Davis's Quadrant*) is of a very commodious Form; at present the most general approved Instrument at Sea (at this Time *Hadley's* particularly excepted) for observing the Sun's Meridian Altitude.

The Form of it (as in the Figure prefixed) may be of any Radius or Length between 18 Inches and 3 Feet; but the most general now made, are Quadrants of 24 Inches Radius, with one Arch 65 Degrees, the other 25 Degrees, with a Glass-Vane and a Shadow-Vane.

The Principal Parts are three Vanes and two Arches; on which Arches the Degrees taken together make 90, from whence it hath the Denomination of a Quadrant.

The

The *Horizon Vane* (marked in the foregoing Figure A, and with its Name) respects the Horizon in Time of Observing; that which gives the Shadow or lucid Spot marked B, is the *Shadow Vane* or *Glass Vane*: And that through which you are to look for both *Shadow* and *Horizon* marked C, is termed the *Sight Vane*. And these are noted in the Figure by their Names.

*Of the two Arches.* The lesser noted D E, is called the 60th Arch, because it formerly contained no more than 60 Degrees, and is so numbered in the Figure, but now it often contains 65, and sometimes 70 Degrees: This Arch is of a small Radius, being so designed that the *Shadow Vane* used on it, being at so small a Distance from the *Horizon Vane*, on which its Shadow, in Time of observing, is to fall might be more visible to the Eye of the Observer.

This *Little Arch* is divided sometimes but into every 5 Degrees, and never less than every single Degree: It is numbered from the upper End E, with 0, 5, 10, 15, 20, &c. downwards to D, where it ends in the Line of ADF, (a Line in the middle of the longer Leg of the Quadrant) at 60, 65, or 70 Degrees, according as the other Arch is divided; so that the Numbers at D and F together, must always make 90 Degrees.

The *Greater Arch* GF, is called the 30th Arch: It is of a larger Radius, that it might contain the lesser Divisions of a Degree; and being of a competent Breadth, thereon are usually described 9 Concentric Circles, intersected with three Diagonal Lines (sometimes six) in each Degree, making each Intersection two Minutes of a Degree, and sometimes one.

The *Great Arch* is divided on the Limb into Degrees by long Strokes; each again subdivided into six equal Parts by shorter Strokes; each small Division being 10 Minutes, and are numbered from the lower End G, with 5, 10, 15, &c. upwards to F, where it ends in the Line ADF, either at 20, 25, or 30 Degrees: The Figures always at F and K, together make 90 Degrees as aforesaid.

The



*The Use of Davis's QUADRANT.*

**T**HIS Instrument is rarely used otherwise than to observe the Sun's Meridian Altitude; which to perform, I thus describe :

1. Put the Horizon Vane A on the End, and, close to the Center; the Sight Vane put on the Arch GF, close to the Back of it, and the Shadow Vane or Glass Vane put on the little Arch DE, close to the back of it, and fix the upper Edge of the Shadow Vane, to a Number of Degrees (on the Side of the 60 Arch) less than the Complement of the Altitude by 15 or 20 Degrees.

2. The Vanes being thus fixed upon the Quadrant, turning your back to the Sun, the End G in your Hand, and F uppermost, look through the Sight Vane, causing the upper Edge of the Shade of the Shadow Vane, or lucid Spot from the Glass Vane to lie upon the upper Edge of the Slit in the Horizon Vane, where is drawn a black Line; at the same time if the Horizon appear through the said Slit in the Horizon Vane, the Vanes on the Quadrant stand at the Sun's present Altitude.

3. But if the Sky appear instead of the Horizon, slide the Sight Vane a little higher towards F; on the contrary, if the Sea appear instead of the Horizon, then slide the Sight Vane lower towards G; continue so to do till the Horizon appear through the Horizon Vane.

4. In order to obtain the Meridian Altitude (which is the greatest Altitude the Sun will have that Day, and the Thing used to find the Latitude) continue observing; and as the Sun rises the Sea will appear through the Horizon Vane; and the Sight Vane must be slid lower accordingly. Thus continue observing as often as may be convenient, till the Sun is at the highest.

5. When the Sun begins to fall, the Sky will appear through the Horizon Vane, instead of the Horizon; then desist observing any more that Day.

6. Having thus done, add the Degrees the upper Edge of the Shade Vane standeth at, to the Degrees and Min. cut by the inside of the Sight Vane, their Sum is the Com-

L

plement

plement of the Sun's Meridian Altitude, or the Distance on the upper Edge of the Sun from the Zenith, to which Sum add 16m. the Sun's Semi-diameter, and the last Sum is the Distance of the Sun's Center from the Zenith, being the true Complement of the Sun's Meridian Altitude.

*Note,* The upper Edge of the Shade of the Shadow Vane respects the upper Limb of the Sun, and the lower Edge of the said Vane answers to the lower Limb of the Sun; so that observing by the first, you are to add 16 Minutes; on the contrary, observing by the latter, subtract 16 Minutes to, or from what is on the Quadrant, the Sum or Difference is the Distance of the Sun's Center from the Zenith, called his Zenith's Distance or Complement of his Meridian Altitude.

Thus I have shewed how to take an Observation with the Quadrant: I come now to shew how to work it. The Difference in working an Observation taken by the Fore-staff and Quadrant is only this: By the Fore-staff you take the Altitude, by the Quadrant the Complement of the Altitude, or the Distance of the Sun from the Zenith.

*Altitude* is the Distance of the Sun from the Horizon; therefore if you subtract the Complement of the Altitude from 90d. the Remainder is the Altitude; which you may use as in the Use of the Fore-staff, in Pages 153 and 154.

But it is usual to work Observations (made by the Quadrant) by the Complement of the Sun's Meridian Altitude; I will therefore give some general Rules, and some particular Examples for their Explanation.

*The General Rules are,*

1. **I**F the Sun hath North Declination, and is upon the Meridian to the Southward of the Observer, add the Sun's Declination to the Zenith Distance, (or Complement of the Sun's Meridian Altitude) the Sum is the Latitude you are in, North.
2. If the Sun be to the Southward of you, and hath South Declination, subtract his Declination from the Zenith



Zenith Distance, the Remainder will be the Latitude you are in, North: But if the Declination exceed the Zenith Distance, subtract the less from the greater, and the Remainder is the Latitude, South.

3. If the Sun be to the Northward of you, and hath South Declination; add the Sun's Declination to his Zenith Distance, the Sum will be the Latitude, South.

4. If the Sun be to the Northward of you, and hath North Declination, subtract the Sun's Declination from his Zenith Distance, the Remainder will be the Latitude South; but if the Declination exceed the Zenith Distance, subtract the less from the greater, and it gives the Latitude, North.

I might have given more general Rules; but if you understand those eight Rules for the Use of the Fore-staff you cannot err in these, in using the Quadrant: And for their Explanation, see the Examples following.

*Working an Observation in North Latitude.*

*Example 1.* ON the 10th of April, 1780, the Sun came to the Meridian in the South, and by Observation, found his Zenith Distance, or Complement of his Meridian Altitude to be 34d. 47m. that is, his upper Limb was so much from the Zenith; I demand the Latitude of the Place of Observation?

	D.	M.
Compl. of the Sun's Meridian Altitude	34	47 South
The Sun's Semidiameter	00	16
<hr/>		
Distance from the Sun's Center from Zenith	35	03 South
Declination	add 08	17 North
<hr/>		
Latitude of the Place required, is	43	20 North

*Example 2.* The 14th Day of August, Anno 1780, I find the Complement of the Sun's Meridian Altitude by Observation, to be 28d. 48m. South; I demand the Latitude the Ship is in?

	D.	M.	
Comp. of the Sun's Meridian Altitude	28	: 48	South
Sun's Semidiameter	-	-	add 00 : 16
Distance of the Sun's Center from Zenith	29	: 04	South
The Sun's Declination	-	-	add 14 : 08 North
The Latitude the Ship is in, is	-	-	43 : 12 North

*Example 3.* October 3, 1780, I find the Complement of the Sun's Meridian Altitude, by Observation to be 47d. 35m. South, I demand the Latitude I am in?

	D.	M.	
Comp. of the Sun's Meridian Altitude	47	: 35	South
Sun's Semidiameter	-	-	add 00 : 16
Distance of the Sun's Center from Zenith	47	: 51	South
The Sun's Declination	-	-	subtract 04 : 18 South
The Latitude the Ship is in, is	-	-	43 : 33 North

*Example 4.* The 5th Day of November, Anno 1782, I find the Complement of the Sun's Meridian Altitude by Observation to be 52d. 00m. South; I demand the Latitude the Ship is in?

	D.	M.	
Comp. of the Sun's Meridian Altitude	52	: 00	South
Sun's Semidiameter	-	-	add 00 : 16
Distance of the Sun's Center from Zenith	52	: 16	South
The Declination of the Sun	-	-	subtract 15 : 49 South
The Latitude the Ship is in, is	-	-	36 : 27 North

*Example 5.* The 27th of May 1782, the Sun being to the Northward of me, and the Complement of his Meridian Altitude by Observation 10d. 15m. I demand the Latitude the Ship is in?

	D.	M.	
Sun's Declination	-	-	21 : 22 North
Comp. of the Sun's Meridian Altitude	-	-	10 : 15 North
The Sun's Semidiameter	-	-	add 00 : 16
The Sun's true Zenith Distance, subtract	10	: 31	North
Latitude the Ship is in, is	-	-	10 : 50 North

*Example*

*Example 6.* Admit on the 20th Day of *June, Anno 1782*, the Sun being upon the Meridian, I find, by Observation, his upper Limb to be 6d. 42m. to the Northward of my Zenith; I demand the Latitude I am in?

	D.	M.
Sun's Declination - - - - -	23	: 15 North
Sun's upper Marg. Distance from Zenith -	06	: 42 North
Sun's Semidiameter - - - - - add	00	: 16
Dist. of the Sun's Center from Zenith sub.	06	: 58 North
Latitude the Ship is in, is - - - - -	16	: 17 North

*Example 7.* The 21st of *July, Anno 1780*, in Longitude 165 Deg. West, and the Sun being upon the Meridian, I find by Observation, the upper Margin of the Sun is 16d. 45m. to the Northward of the Zenith; the Latitude the Ship is in is required?

	D.	M.
The Sun's Declination at <i>London</i> - - -	20	: 21 North
Proportional Min. for Longitude subtract	00	: 05
Sun's Declination in the Meridian given	20	: 16 North
Sun's Supreme Marg. Distance from Zenith	16	: 45 North
Sun's Semidiameter - - - - - add	00	: 16
Sun's Central Dist. from Zenith subtract	17	: 01 North
The Latitude the Ship is in, is - - -	03	: 16 North

*Working an Observation in South Latitude.*

*Example 8.* O N the 14th Day of *July, Anno 1782*, in Longitude 150 Deg. East, the Sun being upon the Meridian, I find the Complement of his Meridian Altitude, by Observation, to be 48d. 28m. North; I demand the Latitude the Ship is in?

	D.	M.
Comp. of the Sun's Meridian Altitude add	48	: 28 North
Sun's Semidiameter - - - - -	00	: 16
<hr/>		
Sun's Central Distance from the Zenith -	48	: 44 North
Sun's Declination for the Long. subtract -	21	: 44
<hr/>		
The Latitude the Ship is in, is - - -	27	: 33 South

*Example 9.* The 25th of *October*, Anno 1781, in Longitude 120 Deg. West, the Complement of the Sun's Meridian Altitude, by Observation, is 27d. 29m. North; I require the Latitude the Ship is in?

	D.	M.
Comp. of the Sun's Meridian Altitude -	27	: 29 North
Sun's Semidiameter - - - - - add	00	: 16
<hr/>		
Sun's Central Distance from the Zenith -	27	: 45 North
The Declination of the Sun's Prop. add	12	: 27 South
<hr/>		
The Latitude the Ship is in, is - - -	40	: 12 South

*Example 10.* Admit that on the 24th of *December*, Anno 1782, I find the Sun upon the South Part of the Meridian, and by Observation the Complement of his Meridian Altitude is 15d. 10m. I demand the Latitude the Ship is in?

	D.	M.
Comp. of the Sun's Meridian Altitude -	15	: 10 South
Sun's Semidiameter - - - - - add	00	: 16
<hr/>		
Sun's Central Dist. from the Zenith subtract	15	: 26 South
The Declination of the Sun - - - -	23	: 27 South
<hr/>		
The Latitude the Ship is in, - - -	08	: 00 South

Thus much I thought necessary to add by way of Explanation upon the foregoing Rules, in Page 162, which exhibit and explain a more perfect and accurate Method, both in taking and working an Observation, than hath been formerly made use of.

*Note 1.* The Sun's Semidiameter here added to the Complement of its Meridian Altitude, may be placed on the Quadrant, so that its Addition by the Pen may be omitted; for this Purpose the Quadrants have on the back Edge of the little Arch (every 5 Degrees numbered, differing from those on the flat Side) the Semidiameter of the Sun: So that placing the upper Edge of the Shadow Vane, to the Degree on the said back Edge of the Arch, the Quadrant then sheweth the true Complement of the Altitude, or the Distance of the Sun's Center from the Zenith; which prevents adding 16 Minutes after observing.

*Note 2.* There is another Contrivance now made use of, which is, by fixing a Convex Glass in such a Manner in the Shade Vane, that the Diameter of the Glass may exactly range with the upper Edge of the said Vane, and which Glass will then, in Time of Observation, cast an illuminated Spot on a round black Spot made in the Horizon Vane: This is useful when the Edge of the Shadow reflected from the Shade Vane is not very conspicuous, the Spot being discernable when the latter is not. The Manner is thus:

Set that Part of the Glass Vane, which is right against the Middle or Center of the Glass, to the Degrees on the Side of the little Arch, and then cause the enlightened Spot of the Glass to lie on the black Spot or Circle on the Horizon Vane; at the same Time look for the Horizon thro' it, as before directed, in Page 160; so you will have (observing by this Glass in the Vane) the true Complement of the Sun's Altitude, or the Distance of his Center from the Zenith.

### *The Description and Use of the NOCTURNAL.*

1. **T**HE *Nocturnal* consists of three Parts; the first, termed the unmoveable Part is the broadest and greatest; on which is a Handle to hold it by in Time of Observation or using it.

On the fore Side of which, in the outermost Circle, are the twelve Months, and each Month subdivided into its respective Days; they are counted towards the left Hand, from the Tip, or nearly so, when you hold it erect by the Handle, and marked with their Names, or the first Letters thereof; as *Jan.* for *January*, *Feb.* for *February*, *Mar.* for *March*, &c. Within the Circle of the Months is a Circle divided into 24 equal Parts or Hours, each Hour divided into Halves and Quarters; used to find the Time of full Sea or high Water.

On the back Side of this Part, are the 32 Points of the *Mariner's Compass* South Uppermost, and East on the Left Hand; to each Point is set the Declination of the North Star, above or under the Pole; which is known by *Und.* for *Under*, *Abo.* for *Above*.

Formerly there was made two Sorts of Nocturnals, one for the Great Bear, the other for the Little Bear: Those made for the Guards, of the Great Bear, or *Charles's Wain*, commonly called the two Pointers, have *February* at the Top; but those made for the Guards of the Little Bear, have *April* at the Top; but they are now made for both Bears in one Nocturnal, and are known by having either two Circles or Months, mark'd GB and LB, or two short Teeth or Indices, proceeding from the second or middle Part of it marked GB and LB, signifying Great Bear or Little Bear.

2. The second moveable middle Part hath two Circles on it; the outermost is divided into the 29 Days and a Half of the Moon's Age; the innermost is divided into 24 equal Parts or Hours, each Hour subdivided into Halves and Quarters; this Part hath a Tooth, or short Index proceeding from it with the Edge continued in a right Line from the Center, which is to be set to the Day of the Month when used. Some have two Indices, marked G on one, and L on the other; G stands for Great Bear, and L for Little Bear; signifying the Nocturnal is made for both Bears, and may be used for either.

3. The

3. <sup>rd</sup>The third and moveable Part is called the Index; it is uppermost on the fore Side of the Instrument, having one Edge proceeding in a right Line from the Center, which (in the Time of Observation) must be turned to the Guards. Through all three Pieces, in the Center of the Instrument, is a Hole, through which you are to see the North Star, when the Index is turned to the Guards.

*The Use of the NOCTURNAL.*

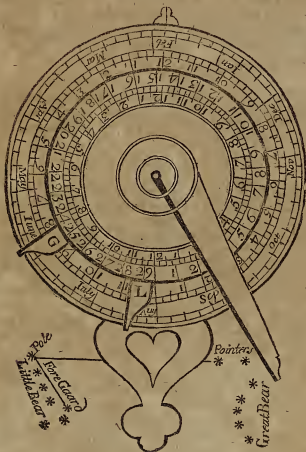
**B**Y it may be found the Hour of the Night, the Bearing of the Guards, and the Declination of the North Star from the Pole; by which may be found the Latitude, as shall be shewed in Order.

*To find the Hour of the Night.*

1. Place the Index of the second or middle Piece, to the Day of the Month where it is to be kept, 'till the Observation is ended; then taking the Handle in your Hand, with the fore Side towards you, and holding it upright, (which you may discern when you do so, by the Tip on the Top of the first or great Part of the Nocturnal) look through the Hole into the Center for the North Star.

2. Turn the Edge of the long Index, which proceedeth from the Center to the Guards, till you see at the same Time, the North Star through that Hole, then will the Index shew the Hour of the Night on the second, or middle Part.

## The Figure of the NOCTURNAL.





2. To find the Bearing of the *Guards*, either of the Little or Great Bear, that is, upon what Point of the Compass they are, and thereby to find the North Star's Declination from the Pole.

1. Having observed all the particular Directions as before, in finding the Hour of the Night, you must see the North Star through the Hole, and the *Guards* by the Edge of the long Index.

2. Then look on the Back-side of the *Nocturnal*, what Point of the Compass standeth against the aforesaid Edge of the Index, which is the Bearing of the *Guards*; and at the said Point of the *Compass* is figured the North Star's Declination from the Pole at that Time either above or under.

*Note*, If the *Nocturnal* is made to fit the *Old Style* the Index must be adjusted in all Problems relating to Time by fixing it eleven Days backward from that Observation.

*Example 1.* The 31st of *December*, at six of the Clock in the Morning, observing the *Pointers* or *Guards* of the Great Bear by the Edge of that Index: I demand their Bearing, and the Declination of the North Star.

Right against the Edge of that Index you observe with, and on the back Side of the *Nocturnal* is SW by S. the Point of the Compass required; and on the said Point of the Compass is 2d. 33m. *und.* signifying the North Star is then 2d. 33m. under the Pole, in the Circle marked G. B.

*Example 2.* The 7th of *March*, I observe (according to the Directions before given) at seven of the Clock in the Evening, the *Fore Guard* of the Little Bear by the Edge of the long Index: I demand its Bearing, and the Declination of the North Star.

Seeing the North Star through the Hole in the Middle, and the *Guard* of the *Little Bear* by the Edge of the long Index, (note always that Edge respecting the Center of the Instrument) and the Index cutting seven of the Clock, on the Back-side of the *Nocturnal*, and against the said Edge of the Index, is N. E. the Point of its Bearing; and on the said Point is figured 0d. 35m. *Abo.* which signifieth the N. Star is then 35 Minutes above the Pole in the Circle marked L. B.

3 *To find the Moon's Southing by the Nocturnal.*

To do this, look for the Moon's Age in the outermost Circle, on the Middle or second Piece of the Nocturnal; and right against it in the innermost Circle of the same Piece is the Southing.

*Example. If the Moon be 19 Days old, I demand her Southing.*

Right against 19, in the outermost Circle, is almost  $3\frac{1}{2}$  in the innermost Circle; which is half an Hour past three of the Clock in the Morning nearly, the Time of the Moon's coming to the South.

*To find the Time of full Sea by the Nocturnal.*

1. Set the short Index of the middle Part which stands at 12, to the Time of full Sea, on the New or Full Moon (for the Place proposed) in the innermost Circle of the great Piece.

2. Keeping it there, bring the long Index to the Moon's (Southing, or) Age on the middle Piece.

3. Then right against the long Index, and in the innermost Circle on the great Piece, is the Time of full Sea required.

*Example. The Moon being 19 Days old, I demand the Time of Full Sea at Gravesend?*

1. Bring the Index of the middle Part (which stands at 12) to  $1\frac{1}{2}$  Hour (which is N.N.E. and S.S.W. the Point of the Compass making Full Sea at *Gravesend*, on the New and Full Moon) in the innermost Circle of 24 Hours on the great Piece, keeping that fast there.

2. Turn the long Index to 19 Days (the Moon's Age, or to  $3\frac{1}{2}$  Hours the Moon's Southing) on the Middle Piece.

3. Then right against the long Index, and in the innermost Circle (on the great Piece) is 5 Hours, the Time of full Sea or high Water in the Morning at *Gravesend*.

5. To find the Latitude by the Nocturnal and Fore Staff.

1. Find the North Star's Declination from the Pole, by observing with the Nocturnal, as directed in Example 1, or 2, of its Use, in Page 171.

2. Then at the same Time with a Fore-Staff, take the Altitude of the North Star.

3. If the North Star be above the Pole, subtract its Declination from (if under, add to) its Altitude; the Sum or Difference is the Latitude required, North.

*Example.* Suppose on the 7th of *March*, at Seven of the Clock in the Evening, observing with the Nocturnal, you find the *Guard* of the *Little Bear* to bear NE. which is *od.* 35m. above the Pole, and at the same Time, by the Fore Staff, find the Altitude of the North Star *42d.* 10m. required the Latitude of the Place?

	D.	M.
From the Altitude of the North Star	-	42 : 10
Subtract its Declination above the Pole	-	00 : 35
Remainder is the Latitude required	- -	41 : 35 North

*Example 2.* On the 31st of *December*, at Six o'Clock in the Morning, observing with the Nocturnal, I find the *Guards* or *Pointers* of the *Great Bear* S. W. by S. which is *2d.* 33m. under the Pole; and at the same Time, by the Fore Staff, find the Altitude of the N. Star *45d.* 22m. I demand the Latitude of the Place of Observation?

	D.	M.
To the Altitude of the North Star	- -	45 : 22
Add its Declination from the Pole under it		02 : 33
Sum is the Latitude required	- - -	47 : 55 North

*The Description and Use of Gunter's Scale.*

**T**HIS Instrument for its quick and easy Dispatch of the most common and useful Proportions, deserves

as generally to be known in its Uses as by its Name: On that Account we shall first give a Description thereof, and then with as much Clearness and Brevity as possible, shew its manifold Uses.

1. *Gunter's Scale*, (so called from Mr. *Gunter*, its first Contriver) is usually made of Box Wood, commonly two Feet long, and one Inch and a half broad; on which are placed the Lines or Scales of Numbers, Sines, Tangents, &c. There are two Sorts, the long or flat *Gunter*, and the sliding *Gunter*: On both Sorts are the same Lines, though differently used; the first Sort with the Compasses, the latter by sliding Pieces.

2. The Lines generally set on *Gunter's* are eight, and have their Names at the Right Hand End thereof, under one another, thus; Sine Rumb, Tang. Rumb, Numbers Sines, Versed Sines, Tangents, Meridian (or Meridional Parts) and equal Parts.

3. The Sine Rumb, and Tang. Rumb, are both Points of the *Mariner's Compass*; the first is figured from the Left Hand towards the Right, with 1, 2, 3, 4, 5, 6, 7, and 8, at which is a Brass Center Pin; the latter is figured thus, 1, 2, 3, and 4, at the said Center Pin; and thence back again towards the Left-Hand with 5, 6, and 7; each Point in both Lines (where it can) is subdivided into Halves and Quarters: These two Lines are only used in Navigation.

4. The next under Tang. Rumb, is the Line of Numbers figured thus: Near the Left Hand End it begins at 1, and towards the Right Hand is 2, 3, 4, 5, 6, 7, 8, 9; then 1 is the middle, at which is a Brass Center Pin going still on 2, 3, 4, 5, 6, 7, 8, 9, and 10, at the End where is another Center Pin: This Line is of general Use, and requires the larger Account, whereof take these three following Notes for the Line of Numbers.

*Note 1.* All the Figures on this Line may be taken singly as they stand; or be increased or diminished at Pleasure, so it be in Decuple or ten Fold Proportion. That is, the first 1 may be counted for 1, or 10, or 100, or 1000, &c. then

then the next 2 is accordingly 2, or 20, or 200, or 2000, &c. Again, the first 1 may be reckoned for 1 Tenth, or 1 Hundreth, or for 1 Thousandth Part, &c. then the next 2 is 2 Tenths, or 2 Hundredths, or 2 Thousand Parts, &c. So that if the First 1 be esteemed 1, the middle 1 is then 10; and two to its Right-hand is then 20, 3 is 30, 4 is 40, and 10 at the end is 100. Again, if the first 1 be counted 10, the next 2 is 20, 3 is 30, and so on, making the Middle 1 now 100; the next 2 is 200, 3 is 300, 4 is 400, and 10 at the End is now 1000.

In like Manner, if the first 1 be esteemed for 1 Tenth Part, the next is 2 Tenths, and the middle 1 is 1; and the next 2 is 2, and 10 at the End is now 10. Again, if the first 1 be counted for 100 Hundredth Part, the next 2 is 2 Hundred Parts; the Middle 1 is now 10 Hundred Parts, or 1 Tenth Part, and the next 2 is 2 Tenth Parts; and 10 at the End is now but 1 whole Number or Integer.

Note 2. *As the Figures are increased or diminished in their Value, so in like Manner must all the intermediate Strokes or Subdivisions be increased or decreased:* That is, if the first 1 (at the left Hand) be counted 1, then 2. (on the right Hand of it is 2; and each Subdivision between them now is one Tenth Part, and so all the Way to the Middle 1, which now is 10; the next 2 is 20. Now the longer Strokes between 1 and 2 are to be counted from 1, thus 11, 12, (where is a Brass Pin) then 13, 14, 15, (something a longer Stroke than the rest) then 16, 17, 18, 19, and 20, at the Figure 2: And all the shorter Strokes between those longer are now each to be counted for a Tenth Part; from the Middle 1 to the next 2, now 20; from whence the longer Strokes between the Figures are Units, thus 21, 22, 23, &c. to 3, which now is 30; and the shorter Strokes between them, each now is 2 Tenth Parts of an Integer: From 3, each short Stroke (or little Division) is five Tenth Parts of an Unit.—

Again,

Again, If 1, at the left Hand be Ten, the Figures between it and the middle 1 are common Tens, and the Subdivisions (between each Figure) are Units, and from the Middle 1 to 10 at the End, each Figure is so many Hundreds; and between these Figures, each longer Division is 10 and from the Middle 1 to 2, each less Division is an Unit; and from 2 to 3, each less Stroke is two Units; from the Figure 3 to the End, each shorter Stroke is five Units.

Some Scales are otherwise subdivided, which the Reader will attend unto, and thence very easily ascertain the Value of each Subdivision, if what is aforementioned be duly understood.

*Note 3.* On the *Line of Numbers* may be counted a Number of any Denomination; whether Measure, as Inches, Feet, Yards, Miles, Leagues, &c. or Weights, as Hundreds, Pounds, Ounces, &c. or Money, as Pounds, Shillings, Pence, &c. or Time, as Years, Months, Days, Hours, &c. provided always the Integer be divided, or supposed to be divided decimally, or into Tens.

5. Next under Numbers, is the *Line of Sines*, beginning at the left Hand, and figured thus, 1, 2, 3, &c. to 10; then 20, 30, 40, &c. to 90, ending at the right Hand, where is a brass center Pin. These Figures never change their Value or Denomination, being here (and in all other Lines under it) called Degrees.

From the Beginning of this Line to 10 Degrees, each Degree is commonly divided into 12 Parts, by longer and shorter Strokes, making each 5 Minutes; from 10 Degrees to 20, each smaller Stroke is 10 Minutes; from 20 to 30 Degrees each is fifteen Minutes from thence to 60 Degrees, some are twenty, but the most are thirty Minutes; and from 60 to 80 Degrees, each Division is a Degree; 80 and 90 are so near together, that they admit but of one Stroke between them, which is for 85 Degrees.

6. Next to the *Line of Sines*, is the *Line of Versed Sines*, beginning at the right Hand against 90, (in the Sines) and from thence figured towards the Left-hand;

thus

thus, 10, 20, 30, 40, &c. ending at (the left Hand End) about 169 Degrees; the Subdivisions are thus, from 10 to 30, each is 2 Degrees; from thence to 90, it is single Degrees; from thence to 120, it is half Degrees; and from thence to the End it is divided each into 15 Minutes.

7. *Under versed Sines* is the *Line of Tangents*, beginning at the left Hand, as the *Sines* do; from thence figured to the right Hand thus, 1, 2, 3, &c. to 10; and so on, 20, 30, 40, and 45 at the right Hand, where is a little Brass Center Pin, just under and even with 90 in the *Sines*; from thence back again it is figured, 50, 60, 70, 80, &c. to 89; ending at the Left Hand End, where it began at 1 Degree: The Subdivisions of the Line are the same of those of the *Sines*.

8. Next to the *Line of Tangents*, and under it is the *Line of Meridional Parts*, beginning at the right Hand, and numbered thus, 10, 20, 30, &c. to the left Hand, where it ends at 87 Degrees. This Line, with the *Line of equal Parts* under it, are used together, only in the *Mercator's Sailing*; the uppermost Line contains the Degrees of the Meridian or Latitude in a *Mercator's Chart*, and the lower is the Equator, and contains the Degrees of Longitude.

9. These eight Lines, thus described, are set on the *Sliding Gunter*, but not in the same Order, being some on one Side, and some on the other: Also the Line of Numbers, Sines, and Tangents, are set double, that is, one on each Side, as the middle Piece slides; which middle Piece is so contrived, as to slip to and fro easily; to slide out, and to be put in, any Side uppermost, in order to range these Lines together or against one another, most proper for solving the Questions wrought by the *Sliding Gunter*; of which, this short Description may suffice.

**I.** *The Use of Gunter's Scale, both single and sliding, in Arithmetic.*

**I**N order to a right Understanding of the Use of this Scale, it is necessary to number well on it; that is, to find readily a Place representing any given Number, Point, or Degree, &c. but chiefly on the Line of Numbers, which is as follows:

**PROBLEM I.** *To find a whole Number on the Line of Numbers.*

**Rule 1.** **L**OOK the first Figure of the given Number among the figured Divisions.

2. For the second Figure, count so many Tenths, (or longer Strokes) from the figured Divisions, towards the right Hand, as are Units in the said second Figure.

3. Then for the third Figure, count from the last Tenth (representing the second Figure) so many lesser Strokes (or Centesms) as that Figure hath Units.

4. In like Manner, for the fourth Figure, count from the last Centesm so many Thousands (or lesser Strokes) as are Units in it; and so on, for more Figures, though four Figures, or Thousands, are as many as can well be discerned on a two-foot Gunter.

5. This done, the last Place is the Point where the propounded Number is represented.

**Example 1.** To find the Point in the Line of Numbers that doth represent 12.

According to the Rule above, I take the Division at the Figure 1 (in the Middle of the Line of Numbers) for the first Figure of 12, the propounded Number; then for 2 the second Figure, I count 2 Tenths (or longer Strokes to the right Hand) from the said Stroke at 12; and this last is the Point representing 12, where most commonly is a small Brass Center Pin, being oft in Use.

*Example*



*Example 2.* Suppose the Point representing 22, on the Line of Numbers, was required to be found?

The first Figure in the Number 22, being 2, I take the Division in the Figure 2 for it; and for the second Figure 2, I count 2 Tenths onwards: And that is the Point representing 22.

*Example 3.* I desire to know the Point on the Line of Numbers that represents 144.

The first Figure being 1, I take the Division at the Middle 1 for it; the second Figure being 4, I count 4 Tenths onwards, and that is 140; from thence count 4 Centens farther, for the third and last Figure; this last Place is the Point representing 144.

*Example 4.* Let it be required to find, on the Line of Numbers, the Point representing 1728.

For the first Figure 1, take the Middle 1 for the second Figure 7, count, as before onward, 7 Tenths, and that is 1700: Then for 2, the third Figure, count 2 Centens from the last, and it represents 1720: Lastly, for the fourth Figure 8, estimate 8 Thousand Parts from the last. This Point last found represents 1728?

PROB.<sup>O</sup> II. To find a Fraction, or broken Number, on the Line of Numbers.

THE Fractions to be found on this Line must always be Decimals; as these, .1 .01 .001; .2 .02 .002, &c. that is,  $\frac{1}{10}$ ,  $\frac{1}{100}$ ,  $\frac{1}{1000}$ ;  $\frac{2}{10}$ ,  $\frac{2}{100}$ ,  $\frac{2}{1000}$  &c. either of Inches, Feet, Yards, Miles, or the like; also in Weight, or Time, or any other Denomination whatsoever.

So that all other Fractions must be reduced into Decimals, before they can be found on the Line of Numbers; and being so reduced, they are expressed and found upon this Line as whole Numbers by the Rule in Problem I. and

PROB. III. *To perform Multiplication by the Line of Numbers.*

The RULE is,

AS 1 is to the Multiplier, so is the Multiplicand to the Product.

Now to work this, or any Proportion on the *Gunter*, this is a general Rule.

1. Extend the Compasses from the first Term to the second Term.

2. That Extent laid the same Way from the third Term, will reach to the fourth Term, or Thing required.

By the *Sliding Gunter* thus;

1. Set the first Term counted on the sliding or middle Piece, right against the second Term counted on the fixed Piece.

Then seek the third Term, (always on the same Piece the first Term was counted upon) and against it on the other Part, is the fourth Term, or Thing required.

*Example 1.* What is the Product of 8 multiplied by 4?

The Analogy or Proportion is this: As 1 is to 4, so is 8 to the Product.

Or it is thus: As 1 is to 8, so is 4 to the Product.

1. By the *Gunter* with Compasses, thus;

Extend the Compasses from 1 to 4; that Extent laid from 8 the (same Way) reacheth to 32, the Product of 8 multiplied by 4.

Or the Extent from 1 to 8, being laid from 4, reacheth to 32, the Product as before.

2. By

2. By the *Sliding Gunter*, thus ;

Set 1 at the Beginning of the middle or sliding Piece, right against 4 on the fixed or outside Piece ; then against 4 on the first, is 32 on the second, the Product required.

Or (set as before) 1 against 8 ; then against 4 on the first, is 32 on the second, the Product, as before.

*Example 2.* What is the Product of 16, multiplied by 5 ?

The Proportion to work it by, is this : As 1 is to 5, so is 16 to the Product.

1. By *Gunter* with *Compasses*, it is thus ;

The Extent from 1 to 5 being laid from 16, reacheth to 80 the Product required.

2. By the *Sliding Gunter* thus ;

Set 1 on the middle Piece, against 5 on the outside Piece, then against 16 on the first, is 80 on the second, the Product as before.

**P R O B. IV.** *To perform Divisions by the Line of Numbers.*

The Rule or Proportion is thus ;

**A**S the Divisor is to 1, so is the Dividend to the Quotient.

*Example 1.* If the Dividend be 64, and the Divisor 4, what is the Quotient ?

To do this, the Proportion is : As 4 is to 1, so is 64 to the Quotient required.

1. By *Gunter* with *Compasses*, thus ;

The Extent from 4 to 1 (laid the same Way) from 64 reacheth to 16, the Quotient required.

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2. By

2. By the *Sliding Gunter*, thus;

Set 4 on the outside Piece, against 1 on the Middle Piece; then against 64 on the first, is 16 on the second, which is the Quotient as before.

*Example 2.* How often is 144 contained in 1728?

To do this, the Proportion is thus: As 144 is to 1, so is 1728 to the Answer, viz. 12.

1. By *Gunter* with Compasses, thus;

The Extent from 144 to 1, reacheth from 1728 to 12, the Quotient and Answer required.

2. By the *Sliding Gunter*, thus;

Set 144 on the outside Piece, against 1 on the middle Piece; then against 1728 on the first, is 12 on the second, which is the Quotient as above.

PROB. V. To reduce a *Vulgar Fraction* to a *Decimal* by the *Line of Numbers*.

TO perform this, the Proportion is thus: As the Denominator of the given Fraction is to its Numerator, so is 1 to the Decimal Fraction required.

*Example.* Suppose it be required to reduce  $\frac{1}{2}$ , a *Vulgar Fraction*, into a *Decimal Fraction*?

*Note.* A *Decimal Fraction* hath for its Denominator an Unit, with as many Cyphers as its Numerator hath Places, and the Proportion to find the Numerator is thus; As 4 is to 3, so is 1 to the Numerator of the *Decimal Fraction* required.

1. By *Gunter* with Compasses, thus;

The Extent from 4 or 3 reacheth (the same Way) from 1 to 75, or  $\frac{75}{100}$  the *Decimal Fraction* required.

2. By

2. By the *Sliding Gunter*, thus;

Set 4 on the outside Piece, against 3 on the middle Piece; then against 1 on the first is 75, or  $\frac{75}{100}$ , on the second, the Decimal Fraction required to be found: So that .75, or  $\frac{75}{100}$  is equal in Value to  $\frac{3}{4}$ .

PROB. VI. *Of Continual Proportion, or Geometric Progression: which is unto two given Numbers, to find a 3d, 4th, 5th, &c Number, in a continual or continued Proportion by the Line of Numbers.*

*The Analogy by which it is effected, is thus;*

**A**S the first given Number is to the second, so is the second to the third, and so is that third to a fourth, and that fourth to a fifth, &c.

*Example.* Let the two Numbers given be 2 and 4, unto which it is required to find a third, fourth, &c. Proportional.

For the Performance hereof, the Rule is thus;

As 2 is to 4, so is 4 to a third; and so is that third to a fourth, &c.

1. By *Gunter* with *Compasses*, thus;

The Extent from 2 to 4 reaches from 4 to 8, the third, and from 8 to 16, the fourth; and from 16 to 32, the fifth proportional Number; and so on, to as many as you please: So that 2, 4, 8, 16, 32, &c. are Numbers in continued Geometric Proportion as was required.

2. By the *Sliding Gunter*; thus

Set 2 on the middle Piece, to 4 on the outside Piece: then against 4 on the first, is 8 on the Second, for the third Proportional; and against 8 on the first is 16 on the second, the fourth Proportional; and in like manner against 16 is 32, the fifth Proportional, as was required: And so on for more,

PROB.

**PROB. VII.** *Of the Rule of Three Direct, or three Numbers being given, to find a fourth in a direct Proportion by the Line of Numbers.*

The Analogy whereby this is performed, is thus :

**A**S the first Number is to the second, so is the third to the fourth Number required.

*Example 1.* If the Diameter of a Circle be 7 Inches, and the Circumference thereof 22, what is the Circumference of a Circle, whose Diameter is 14 Inches ?

To perform this, the Analogy is thus ; as 7 is to 22, so is 14 to the Circumference required.

1. By *Gunter* with Compasses, thus ;

The Extent from 7 to 22 (laid the same Way) from 14, will reach to 44, the Circumference of the Circle, whose Diameter is 14, which was required.

2. By the *Sliding Gunter*, thus ;

Set 7 on the middle Piece, against 22 on the outside Piece ; then against 14 on the first, is 44 on the second, which is the Circumference as above.

*Example 2.* If the Circumference of a Circle be 3.14 or  $3\frac{14}{100}$ , and its Diameter 1, what will the Diameter of another Circle be, whose Circumference is 44 ?

The Proportion is, as  $3\frac{14}{100}$  is to 1, so is 44 to the Diameter required.

1. By *Gunter* with Compasses, thus ;

The Extent from  $3\frac{14}{100}$  to 1, reacheth from 44 to 14 nearly, the Diameter required.

2. By the *Sliding Gunter*, thus ;

Set  $3\frac{14}{100}$  on the outside Piece, right against 1 on the middle Piece ; then against 44 on the first, is 14 on the second, which is the Diameter required, as before.

*Nota,*

*Note,* In the *Rule of Three Direct*, if the third Number be greater than the first, then will the fourth Number be greater than the second: But if the third Number be less than the first, then the fourth will be less than the second.

*Example 3.* If 30 Acres of Land be worth 25 Pounds a Year, how much a Year will 54 Acres be worth?

To do this, or any Question in the *Rule of Three*, always in the Proportion let the first and third Numbers or Terms be of one Kind or Denomination, and then it is thus: As 30 Acres is to 25 Pounds, so is 54 Acres to 45 Pounds.

1. By the *Gunter* with Compasses, thus;

The Extent from 30 to 25, reacheth from 54 to 45, the yearly Rent required.

2. By the *Sliding Gunter*, it is thus;

Set 30 against 25, then against 54 on the first, is 45 on the second, as before.

By this Time the Reader is, we presume, so well acquainted in the Way of working a Proportion on the Line of Numbers, with Compasses or without, that it is needless to express it in Words any more, being always the same: We shall therefore for the future set down the Proportion, leaving the Manner of its Operation to Practice, except in Cases where the working differs from what went before.

**PROB. VIII.** *Of the Rule of Proportion Inverse, or three Numbers given to find a fourth in an Inverse Proportion, or in the backward Rule of Three, by the Line of Numbers.*

**I**N this Rule you must note, if the third Number be greater than the first, then will the fourth be less than the second. But,

2. If

2. If the third be less than the first, the fourth is to be greater than the second.

3. And to resolve Questions in the backward Rule of Three, the Proportion is thus;

As the third Number is to the second, so is the first to the fourth.

*Example.* If 72 Pioneers make a Trench in 48 Hours, in how long Time will 54 Pioneers make it?

By the Directions above, this is the Proportion: As 54 Men is to 48 Hours, so is 72 Men to 64 Hours, the Answer to the Question, from whence you may conclude that 54 Men will perform as much in 64 Hours, as 72 Men in 48 Hours.

**PROB. IX.** *Of Duplicate Proportion, or three Numbers being given, to find a fourth in a Duplicate Proportion by the Line of Numbers.*

**T**HIS Rule is chiefly used in Proportion of Lines to Superficies, &c. wherein the first and second Terms are to be of one Kind or Denomination.

*Example 1.* If the Diameter of a Circle be 1, and its Area or Content 0.78539, what is the Content of a Circle whose Diameter is 14?

To perform this, the first and second Terms, (by the Note above) are to be Lines; that is, the Diameters given, and then the Proportion is thus: As 1 is to 14; so is 0.785 to a fourth; and so is that fourth to the Content required.

1. By Gunter with Compasses, thus;

The Extent from 1 to 14 reacheth from 0.785 to 11; and the same Extent laid the same Way from 11 reacheth to 154, the Content required.

2. By



2. By the *Sliding Gunter*, it is thus;

Bring 1 on the middle Piece right against 14 on the outside Piece; then against 0.785 on the first, is 11 on the second; and against 11 on the first, is 154 on the second, the Content as before.

*Example 2.* If the Diameter of a Circle be 7, and its Area 38.5 what is the Area of a Circle whose Diameter is 12? *Answer* 113. For,

As 7 is to 12, so is 38.5 to 66; and so is 66 to 113, the Area required.

*Example 3.* If the Diameter of a Circle be 1, and its Area 0.785, what is the Diameter of a Circle whose Area is 154? *Answer*, 14 is its Diameter.

In this, the Proportion is a Superfices to a Line, which is thus: As Area 0.785 is to Area 154, so is the Square of the Diameter 1, to the Square of the Diameter required.

1. By *Gunter* with the Compasses, it is thus;

The Extent from 0.785 to 154 reacheth from 1 to 196, the Square of the Diameter required.

Then divide the Space between 1 (always the Middle 1) if the Number of Places be odd, but if even, the first 1) and 196 into two equal Parts; the Foot of the Compasses in the Middle resteth at 14, the Diameter of the Circle, whose Area is 154.

2. By the *Sliding Gunter*, it is thus;

Set 0.785 against 154, and against 1 on the first, is 196, on the second; then find the Middle between 1 and 196, which is at 14, the Diameter as before.

*Example 4.* The Diameter of a Circle being 1, and its Area 0.785, what is the Diameter of a Circle whose Area is 113? *Answer*, 12 is the Diameter required.

For as 0.785 is to 113: so is 1 to 144; the Middle between it and 1, is to 12, the Diameter required.

PROB.

**PROB. X.** *Of Triplicate Proportion, or three Numbers being given, to find a fourth in a Triplicate Proportion by the Line of Numbers.*

**T**HIS Problem concerneth the Proportion of Lines to Solids, and the contrary; in which always make the first and second Term to be of one Denomination.

*Example 1.* If an Iron Bullet weigh 9 Pounds, and its Diameter be 4 Inches, what is the Weight of another Iron Bullet, whose Diameter is 6 Inches.

To perform this, the first and second Terms are to be Lines, that is, the given Diameters; and then the Proportion is thus:

As 4 is to 6, so is 9 to 13.5; and so is 13.5 to 20.2: and so is 20.2 to 30.3; that is, 30 Pounds and 3 Tenths of a Pound, which is the Weight required.

That is, 1. By *Gunter* with Compasses, thus;

The Extent from 4 to 6 being laid three Times from 9, will reach to 30 Pounds 3 Tenths, the Weight required.

And, 2. By the *Sliding Gunter*, it is thus;

Set 4 against 6, and against 9 on the first is 13.5 on the second; then against 13.5 on the first, is 20.2 on the second; and against 20.2 on the first, is 30.3 on the second, that is 30 Pounds 3 Tenths, as before.

*Example 2.* If an Iron Bullet 1 Inch Diameter, weigh Pounds 0.1406 Parts, what is the Weight of another whose Diameter is 4 Inches, it being of the same Metal? Answer, 9 Pounds. For,

As 1 is to 4, so is 0.1406 to 0.562; and so is 0.562 to 2.25; and so is 2.25 to 9 Pounds, the Weight required.

*Example*

*Example 3.* If a Gun 6 Inches Bore require 11 Pounds of Powder, how much will serve a Gun 4 Inches Bore? Answer, Pounds 3.25 Parts.

For, As 6 is to 4, so is 11 to 7.3; and so is 7.3 to 4.88; and so is 4.88 to 3.25; which is Pounds 3.25 Parts of a Pound, or Pounds  $3\frac{1}{4}$  of Powder.

*Example 4.* If an Iron Bullet 1 Inch Diameter weigh Pounds 0.1406 Parts, what shall the Diameter of that be, which weigheth 9 Pounds of the same Metal? Answer,

For it is thus: As 0.1406 is to 9, so is 1 to 64, the Cube of the Diameter required; then divide the Space between 1 and 64 into 3 equal Parts, and the Foot of the Compasses in the first  $\frac{1}{3}$  Part from 1 reaching to 4, the Diameter of the Iron Shot weighing 9 Pounds.

II. *The Use of the Line of Numbers, commonly called Gunter's Line, in measuring Superficies, as Board, Glass, Land, &c.*

PROB. I. *The Length and Breadth of any Square, or Long-square, Superficies being given, to find the Area or Content thereof.*

THE Proportion is this; As 1 is to the Breadth, so is the Length to the Content.

*Example 1.* A Plane Superficies, as a Board or Plank, being given to be measured, the Breadth thereof is 15 Inches, and its Length 61 Inches; what is the Content of it? Answer, 915 Inches.

For, as 1 is to 15, so is 61 to 915 Inches, the Content required.

*Note,* Such as the Breadth and Length are, such is the Content; so that if the Breadth and Length be Feet, the Content is Feet; if Perches, then Perches, &c.

*Example*

*Example 2.* A Piece of Wainscot in Form of a long Square, whose Length is Feet 15.5 Parts, and Breadth Feet 2.25 Parts; what is the Content? *Answer,* Feet 34.87 Parts. For as 1 is to 2.25 so is 15.5 to 34.87; that is, Feet 34 and 87 Parts is the Content.

**PROB. II.** *The Breadth and Length of a Superficies being given in one Kind of Measure, to find the Content thereof in another Kind of Measure.*

**TO** do this the Proportion is thus: As the Number contained in the Area of Unity in the required Kind of Measure, is to the Breadth; so is the Length to the Content desired.

*Example 3.* A Plank or Board 15 Inches broad, 61 Inches long, I demand the Content of it in Feet? *Answer,* Feet 6.35 Parts of a Foot. For you must note in a Foot Superficial, or a Square Foot, is 144 square Inches, and therefore the Proportion is thus: As 144 is to 15 Inches, so is 61 Inches to Feet 6.35 Parts of a Foot, the Content.

*Example 4.* A Piece of Land in Form of a Long Square, whose Breadth is 30 Perches, Length 183 Perches: What is the Content in Acres? *Answer,* Acres 34 31 Parts.

*Note,* 160 Perches is an Acre, and the Proportion is thus: As 160 Perches is to 30 Perches, so is 183 Perches to Acres 34.43 Parts of an Acre, the Content of the Piece of Land.

*Example 5.* A Piece of Painting in Form of a Long Square, whose Breadth in Feet is 3.5, and its Length 21 Feet, how many Square Yards is the Content? *Answer,* Yards 8.16 Parts of a Yard.

*Note,* 9 Feet is a Square Yard, and the Proportion is thus;

As 9 is to 3.5 Feet, so is 21 Feet to Yards 8.16 Parts of a Yard, the Content.

P R O B.

**PROB. III.** *The Breadth of a Superficies being given in one Kind of Measure, and the Length in another; to find the Content in the greater Measure.*

**TO** do this, the Proportion is thus: As so many of the lesser Kind of the given Measure, as is equal to the Length of one of the required Measure, is to the given lesser Measure, so is the given greater Measure, to the Content in the Measure required.

*Example 6.* Admit there be a Board of 10 Inches broad, and 20 Feet long, I demand the Content in Feet? *Answer,* Feet 16.6 Tenths of a Foot.

For the Proportion is thus: As 12 is to 10 Inches, so is 20 Feet to 16.6 Tenths.

*Example 7.* If a Board or Plank be 15 Inches broad, and 27 Feet long, what is the Content of it in Feet? *Answer,* Feet 33.75 Parts of a Foot; or  $33\frac{3}{4}$  Feet. For as 12 is to 15 Inches, so is 27 Feet to 33.75 Parts.

*Example 8.* A Board  $7\frac{1}{2}$  Inches broad, and  $29\frac{1}{4}$  Feet long, what is the Content in Feet? *Answer,* Feet 18.28. For, it is as 12 is to  $7\frac{1}{2}$ ; so is  $29\frac{1}{4}$  to Feet 18.28 Parts.

*Example 9.* A Piece of Land in Form of a long Square, whose Breadth is 30 Perches, and Length in Chains 15.25 Links (measured by a Chain of 4 Perches in 100 Links). I demand the Content thereof in Acres? *Answer,* Acres 11.44. For it is, As 40 is to 30 Perches, so is Chains 15.25 to Acres 11.44 Parts of an Acre.

**PROB. IV.** *The Breadth of a Superficies being given to find how much in Length will make a Foot, a Yard, a Perch, or an Acre, &c.*

**TO** do this, take this general Rule: As the Breadth is to a Foot, a Yard, &c. so is a Foot, a Yard, &c. to that Length which will make a Foot, a Yard, &c.

*Example*

*Example 10.* If a Board be  $7\frac{1}{2}$  Inches broad, how much in Length will make a Foot square? Answer, Inches 19.2 Tenth's of an Inch.

For the Proportion is thus: As 7.5 is to 12, so is 12 to Inches 19.2 Tenth's in Length, which will make a Foot.

*Example 11.* A Plank is 30 Inches broad, how much in Length will make a Foot? Answer, Inches 4.8 Tenth's in of an Inch.

For as 30 Inches is to 12, so is 12 Inches to 4.8 Tenth's in Length to make a Foot.

*Example 12.* A Pane of Glass being in Breadth Feet 2.5 Tenth's, how much in Length will make a Foot? Answer, 4 Tenth's of a Foot. For it is thus;

As 2.5 is to 1 Foot, so is 1 Foot to 0.4 Tenth's of a Foot in Length to make a Foot.

*Example 13.* A Piece of Matting being 27 Inches broad how much in Length will make a Yard square? Answer 48 Inches, or 4 Feet. For it is thus;

As 27 Inches is to 36 Inches, so is 36 Inches to 48 Inches: But if the Breadth be given in Feet, that is, if for 27 Inches it be  $2\frac{3}{4}$  Feet, or 2.25 Feet, then it is thus;

As 2.25 is to 3 Feet, so is 3 Feet to 4 Feet in Length, to make a Yard square.

**PROB. V.** *The Diameter of a Circle being given, to find the Circumference.*

**T**HE Analogy or Proportion is thus: As 1 is to 3.142 so is the Diameter to its Circumference.

*Example 14.* If the Diameter of a Circle be 15 Inches, what is the Circumference of it? Answer, Inches 47.13 Parts of an Inch.

For, as 1 is to 3.142, so is 15 Inches to Inches 47.13 Parts, the Circumference required.

P R O B.

PROB. VI. *The Circumference of a Circle being given, to find its Diameter.*

THE Proportion is this: As 3.142 is to 1, so is the Circumference to its Diameter.

*Example 15.* The Circumference of a Circle being 44 Feet, what is the Diameter thereof? *Answer* Feet 14, for it is,

As 3.142 is to 1, so is 44 Feet; to Feet 14 the Diameter.

PROB. VII. *The Diameter of a Circle being given, to find its Area, or superficial Content.*

The Proportion is thus :

AS 1 is to the Diameter, so is 0.7854 to a fourth Number, and so is that fourth Number to the superficial Content required.

*Example 16.* The Diameter of a Circle being 15 Inches, what is the Content of it? *Answer*, Inches 176.7 Parts.

For it is, as 1 to 15, so is 0.7854 to 11.78; and so is 11.78 to 176.7 the superficial Content required.

PROB. VIII. *The Circumference of a Circle being given, to find the superficial Content of it.*

The Proportion is this :

AS 1 is to the Circumference, so is 0.07958 to a fourth Number, and so is that fourth Number to the superficial Content required.

*Example 17.* If the Circumference of a Circle be 44 Inches, what is the Content? *Answer*, Inches 154.06 Part of an Inch. For it is,

As 1 is to 44, so is 0.7958 to 3.5; and so is 3.5 to Inches 154.06, the Content required.

III. *The Use of the Line of Numbers, in solid Measure, such as Timber, Stone, Gauging, &c.*

PROB. I. *The Side of a Square Solid being given in Inches, to find how much in Length will make a Foot Solid.*

THE Proportion is thus : As the given Side is to 12, so is 12 to a fourth Number ; and so is that fourth Number to the Length required to make a Foot Solid.

*Example 1.* A square Piece of Timber or Stone, whose Breadth and Depth are each 8 Inches ; how much in Length will make a Foot Solid ? *Answer*, 27 Inches, or 2 Feet 3 Inches : For it is, as 8 is to 12, so is 12 to 18 ; and so is 18 to 27 Inches in Length, to make a Foot.

*Example 2.* A square Piece of Timber or Stone, whose Side is 2 Feet or 24 Inches ; how much in Length will make a Foot ? *Answer*, 3 Inches. For it is, as 24 is to 12, so is 12 to 6 ; and so is 6 to 3 Inches in Length, to make a Foot Solid.

PROB. II. *The Side of a Square Solid given in Foot Measure, (that is, the Decimal Foot, or a Foot divided into 100 equal Parts) to find how much in Length will make a Foot-Solid.*

THE Proportion is thus : As the given Side is to 1, so is 1 to a fourth Number ; and so is that fourth Number to the Length required to make a Foot Solid.

*Example 3.* A square Piece of Timber whose Side is Feet 1.52 Parts ; how much in Length will make a Foot Solid ? *Answer*, 0.432 Parts of a Foot. For it is as 1.52 is to 1, so is 1 to 0.658 ; and so is 0.658 to 0.432 Parts of a Foot.

P R O B.



PROB. III. *The Breadth and Depth of a Solid, whose two Ends are equal long Squares; (viz. Rectangles) being given in Inches, or in Foot Measure; to find how much in Length will make a Foot Solid.*

THE Proportion for Inches is thus: As 12 is to the Breadth, so is the Depth to a fourth Number: Then,

As that fourth Number is to 12, so is 12 to the Length in Inches to make a Foot Solid.

2. The Proportion for Foot-Measure is thus: As 1 is to the Breadth, so is the Depth to a fourth Number; and then, as that fourth Number is to 1, so is 1 to the Length in Foot-Measure, to make a Foot Solid.

*Example 4.* A Piece of Timber or Stone, whose Breadth is 11, and Depth 19 Inches; how much in Length will make a Foot? *Answer*, Inches 8.27 Parts. For it is as 12 is to 11, so is 19 to 17.4: And then say, as 17.4 is to 12, so is 12 to Inches 8.27 Parts in Length, to make a Foot Solid.

*Example 5.* A Piece of Timber, in Breadth Feet 0.75 Parts, and Depth Foot 1.25 Parts; how much in Length will make a Foot Solid? *Answer*, Foot 1.06 Parts. For it is, as 1 is to 0.75, so is 1.25 to 0.94: Then say, as 0.94 is to 1, so is 1 to Foot 1.06 Parts in Length, to make a Foot Solid.

PROB. IV. *The Side of a Square Solid, and its Length being given, to find the Content.*

1. **W**HEN the Side is given in Inches, and Length in Feet, the Proportion is thus: As 12 is to the given Side, so is the Length to a fourth Number; and so is that fourth Number to the Content in Feet.

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2. When

When the Side and Length are both given in Foot-Measure, the Proportion is thus. As 1 is to be given Side; so is the Length to a fourth Number; and so is that fourth Number to the Content required.

*Example 6.* A Square Piece of Timber, whose Side is 9 Inches, and Length 35 Feet; how many Feet of Timber are in it? *Answer*, Feet 19.68 Parts. For it is,

As 12 is to 9, so is 35 to 26.25; and so is 26.25 to Feet 19.68 Parts, the Content required.

*Example 7.* A Piece of Timber 16 Inches square, and 28 Feet long, how much is the Content? *Answer* 50 Feet.

For it is, as 12 is to 16, so is 28 to 37.3, and so is 37.3 to 49.8 Feet, the Content of the Piece of Timber.

*Example 8.* A Stone, Feet 2.75 Parts Square, and Feet 7.50 Parts long, how much is the Content? *Answer* Feet 56.72 Parts.

For it is, as 1 is to 2.75, so is 7.50 to 20.6; and so is 20.6 to Feet 56.72 Parts, the Content required.

**P R O B. V.** *The Length, Breadth, and Depth of a Square Solid being given, to find the Solid Content.*

1. **I**F the Breadth and Depth be given in Inches, and the Length in Feet, the Proportion is thus: As 12 is to the Breadth, so is the Depth to a fourth Number. Then say, As 12 is to that fourth Number, so is the Length in Feet to the Content in Feet.

2. When the Length, Breadth and Depth are all given in Foot-Measure, then the Proportion is thus: As 1 is to the Breadth, so is the Depth to a fourth Number: And then again say, As 1 is to that fourth Number, so is the Length to the Content in Feet.

*Example 9.* If a square Piece of Timber be in Breadth 19 Inches, Depth 11 Inches, and 20 Feet long; how much is the Solid Content? *Answer*, Feet 29.03 Parts.

For it is thus: As 12, is to 19; so is 11, 17.4 Then say,

say, as 12 is to 17.4 so is 20 to Feet 29.03 Parts the Content required.

*Example 10.* A Stone 20 Inches broad, 13 Inches deep, and Feet  $15\frac{1}{4}$  or  $15\frac{25}{100}$  Feet in Length; How much is the Content? *Answer*, Feet 27.5.

For it is, as 12, is to 20; so is 13, to 21.67: And then as 12 is to 21.67; so is 15.25, to 27.5, that is  $27\frac{1}{2}$  Feet is the Content.

*Example 11.* A square Piece of Timber, Feet 1.25 broad, Feet 0.56 deep, and 36 Feet long; how much is the Content? *Answer*, Feet 25.20 Parts, or  $25\frac{20}{100}$  Feet. For it is,

As 1, is to 1.25; so is 0.56, to 0.7; and then say, as 1 is to 0.7; so is 36 to Feet 25.2 Tenths, the Content required.

**PROB. VI.** *The Diameter of a Cylinder being given, to find how much in length will make a Foot Solid.*

1. **I**F the Diameter be given in Inches, the Proportion is thus: As the given Diameter is to 13.531; so is 12 to a fourth Number; and so is that fourth Number to the Length required to make a Foot Solid.

2. When the Diameter is given in Foot Measure, the Proportion is thus: As the given Diameter is to 1.128; so is 1 to a fourth Number, and so is that fourth Number to the Length, which will make a Foot Solid.

*Example 12.* A round Piece of Timber, or Stone, being 15 Inches Diameter; how much in Length will make a Foot Solid? *Answer*, Inches 9.76 Parts of an Inch. For it is,

As 15 is to 13.531; so is 12 to 10.82, and so is 10.82 to Inches 9.76 Parts, or  $9\frac{76}{100}$  Inches: But supposing the Diameter of the same to be taken in Foot Measure, then the Question is Foot 1.25 Parts; and how much will make a Foot Solid? *Answer*, Foot 0.81 Parts of a Foot.

For it is thus: As 1.25, is to 1.28; so is 1 to 0.902; and so is 0.902, to Foot 0.815 Parts, or  $\frac{815}{1000}$  Foot to make a Solid Foot.

**PROB. VII.** *The Circumference of a Cylinder being given, to find how much in Length will make a Foot Solid.*

1. **W**HEN the Circumference is given in Inches, the Proportion is,

As the Circumference is to 42.54, so is 12 to a fourth Number, and so is that fourth Number to the Length required to make a Foot Solid.

2. But if the Circumference be given in Foot Measure, then the Proportion is,

As the Circumference is to 3.545, so is 1 to a fourth Number; and so is that fourth Number to the Length, to make a Foot Solid.

*Example 3.* If a round Stone or Tree, be 44 Inches about, how much in Length will make a Foot? *Answer*, Inches 11.22 Parts. For it is,

As 44 is to 42.54, so is 12 to 11.6; and so is 11.6 to Inches 11.22 Parts of an Inch, or  $\frac{11.22}{100}$  Inches.

But suppose the same was measured by Foot-Measure, and the Circumference found to be Feet 3.67 Parts, how much in Length will make a Foot? *Answer*, Foot 0.933 Parts, or  $\frac{933}{1000}$ . For it is thus;

As 3.67, is to 3.545; so is 1, to 0.966; and so is 0.966 to Foot 0.933 Parts, or  $\frac{933}{1000}$  Foot.

**PROB. VIII.** *The Diameter and Length of a Cylinder being given, to find the Solid Content.*

1. **W**HEN the Diameter is given in Inches, and Length in Feet, the Proportion is thus;

As 13.531 is to the Diameter, so is the Length to a fourth Number; and so is that fourth Number to the Solid Content in Feet.

2. If the Diameter and Length are both given in Foot-Measure, then the Proportion is thus;

Course

As 1.128 is to the Diameter, so is the Length to a fourth Number; and so is that fourth Number to the Content required.

*Example 14.* A round Piece of Timber 10 Inches thro' and 30 Feet long; how many Feet of Timber are in it? *Answer,* Feet 16.38 Parts. For it is, as 13.531 is to 10, so is 30, to 22.16; and so is 22.16, to Feet 16.38 Parts of a Foot, or 16 Feet.

But suppose the same Piece is measured by Foot Measure; then it is Feet to 0.83 Parts through, and the Work is thus:

As 1.128 is to 83, or 0.83, so is 30 to 22.16; and so is 22.16 to Feet 16.38 Parts, or  $16\frac{38}{100}$  Feet as before.

**PROB. IX.** *The Circumference and Length of a Cylinder, being given, to find the Solid Content.*

1. If the Circumference be given in Inches, and the Length in Feet, the Proportion is thus: As 42.54 is to the Circumference, so is the Length to a fourth Number; and so is that fourth Number to the Solid Content in Feet.

2. When the Circumference and Length are both given in Foot-Measure, if the first Term be made 3.545 (instead of 42.54) the former Words will serve.

*Example 15.* A round Stone or Tree, being 30 Inches about, and 25 Feet long, how many Feet Solid are in it? *Answer,* Feet 12.43 Parts. For it is thus: As 42.54 is to 30, so is 25 to 17.63; and so is 17.63 to Feet 12.43 Parts or  $12\frac{43}{100}$  Feet.

Now the Compass about being taken in Foot-Measure is Feet 2.50 Parts, and the Proportion is, as 3.545 is to 2.50, so is 25 to 17.63; and so is 17.63 to Feet 12.43 Parts, or  $12\frac{43}{100}$  Feet as above.

*Note,* When Timber Tapers, that is, bigger at one End than at the other, it is usual to take the Breadth and Depth in the Middle of its Length, and by them to measure the Pieces as if both Ends were of a Bigness.



As  $\left\{ \begin{array}{l} 18.95 \\ 17.15 \end{array} \right\}$  is to 25.6; so is 40, to  $\left\{ \begin{array}{l} 54 \\ 59.71 \end{array} \right\}$  and so is  
 $\left\{ \begin{array}{l} 54 \\ 59.71 \end{array} \right\}$  to  $\left\{ \begin{array}{l} 73 \\ 89.12 \end{array} \right\}$  Beer Wine } Gallons.

1. By *Gunter* with *Compasses*, thus ;

1. The Extent from 1 to 0.7 will reach the same Way from 8 to 5.6 ; which being added to 20 ; the Head Diameter, make 25.6 from the mean Diameter : Then

2. The Extent from 18.95 (the Gauge Point of Beer) to 25.6 will reach from 40, to 54 ; and that Extent turned over again reaches to 73, the Content in Beer Gallons.

In like Manner the Extent from 17.15 (the Gauge Point of Wine) to 25.6, being laid twice from 40, will reach to 89.12 the Wine Gallons.

2. By the *Sliding Gunter*, thus ;

1. Set 1 against 0.7, and against 8 on the First, is 15.6 on the Second ; which added to 20 (the Head Diameter) makes 25.6 for the mean Diameter : Then

2. Set 18.95 (the Gauge Point for Beer) on the First, against 25.6 on the Second ; then against 54 on the First, is 73 on the Second, the Content in Beer Gallons.

Also, if you set the Gauge Point for Wine 17.15 against the mean Diameter 25.6, then against the Length of the Cask 40 on the First, you will find 59.71 on the Second ; and against 59.71 on the First, will be had on the Second 89.12 the Content in Wine Gallons.

**P R O B. XL** *The Length of a Ship's Keel and Breadth at the Beam being given to find her Tonage.*

**I**T is the Practice of Shipwrights about *London*, to multiply the Length of the Keel, and Breadth and Half Breadth at the Beam, into one another, and to divide the last Product by 94, whose Quotient they count for the Ship's Tonage ; from whence I frame the following Proportions to be wrought by the Line of Numbers.

1. As

1. As 188 is to the Breadth, so is the Breadth to a fourth Number: Then say,

2. As 1 is to that fourth Number, so is the Length to the Tonnage required.

*Example 17.* Suppose a Ship 72 Feet by the Keel, and 24 Feet by the Beam: I demand her Tonnage? *Answer,* Tons 220.6 Tenths nearest. See the following Work;

As 188 is to 24, so is 24 to 3.06, and then,

As 1 is to 3.06, so is 72 to Tons 220.6 Tenths.

1. By *Gunter* with *Compasses*, thus;

1. The Extent from the given Number 188, to the Breadth of the Beam 24, will reach from (the said Breadth) 24 to 3.06. Then,

The Extent from 1 to 3.06, will reach from the Length of the Keel 72, to the Tons 220.3 Tenths, the Tonnage required.

Or more briefly thus: The Extent from 13.71 (which is the Square Root of the given Number 188) to the Breadth of the Beam 24, being turned over twice from the Length of the Keel 72, reacheth to Tons 220.3 as before.

2. By the *Sliding Gunter*, thus;

1. Set the given Number 188, against the Breadth of the Ship 24, then against the said Breadth 24 on the first is 3.06 on the second: Then,

2. Set 1 against 3.06, and against the Length of the Keel 72 on the first, is Tons 220.3 Tenths on the second, as before.

**PROB. XII.** *To find the Tonnage of a Box, Bale or Case, having it's Length, Breadth and Depth given.*

The **R U L E** is this,

1. **A**S 66 is to the Breadth, so is the Depth to a fourth Number: Then,

2. As 1 is to that fourth Number, so is the Length to its Tonnage required.

*Example*



*Example 18.* A Case or Bale being 6 Feet broad, 4 Feet deep, and 10 Feet long, I demand its Tonage? *Answer,* Tons 3.60 Parts. For it is thus;

1. By *Gunter's Scale* with *Compasses*.

1. The Extent from the given Number 66 to the Breadth 6, reacheth from the Depth 4 to 0.363: Then,

2. The Extent from 1 to the last found Number 0.363, being laid from the Length 10, reacheth to 3.63; that is 3 Tons, and 63 Parts of 100, or  $\frac{63}{100}$  Tons.

By the *Sliding Gunter*, thus;

1. Set the given Number 66, against the Breadth of the Bale or Case 6; then against the Depth of it 4 on the first, you will find 0.363 on the second, a fourth proportional Number: Then,

2. Set 1 against the said Proportional Number 0.363, and against the Length of the Bale or Case 10 on the first, will be found on the second, 3.63, or  $3\frac{63}{100}$ , the Tonage of the Bale or Case proposed.

*Note;* That 66 Feet is the Content of a Case that will inclose two *English Butts*, but the Cantlings of them are better than a third Part; therefore allowing 26 Feet for the Cantlings, the remaining 40 Feet are counted 1 Ton. And the Rule is,

1. By the *Gunter* with *Compasses*, for the aforesaid *Examp.*

1. The Extent from the given Number 40, to the Breadth of the Case or Bale 6, will reach from the Depth 4 to 0.6, a fourth Proportional Number: Then,

2. The Extent from 1, to the said fourth Number 0.6, will reach the same Way, from the Length 10, to 6 Tons, the Content of the Case or Bale required.

2. By the *Sliding Gunter*, thus;

1. Set the given Number 40, against the Breadth of the Bale or Case 6, then against the Depth of it 4, on the first, is 0.6 on the Second, a fourth Proportional Number: Then,

2. Set 1 against the said Proportional Number 0.6, and against the Length of the Bale or Case 10 on the First, you

you will find on the Second 6, the Tonage of the Bale or Case proposed.

PBOB. XIII. *The Diameteer of a Globe being given, to find the Solid Content.*

The R U L E.

AS 1, is to the Diameter; so is 0.5236, to a fourth Number; and so is that fourth Number to a fifth; and so is this fifth, to its solid Content required.

*Example 19.* A Globe whose Diameter is 8 Inches, what is the solid Content? *Answer*, Inches 268. For it is wrought thus:

As 1. is to 8, so is 0.5236, to 4.19; and so is 4.19, to 33.5; and so is 33.5, to 268 Inches the solid Content of the Globe.

IV. *The Use of the Line of Numbers in Gunnery.*

P R O B. I. *The Diameter and Weight of any Piece of Ordnance being known, to find the Weight of any other being of the same Metal and Shape, and its Diameter known*

Like Solids are in Proportion, as the Cubes of their homologs Sides. Therefore the Rule is thus:

AS the Diameter of the known Gun, is to the Diameter of the Gun whose Weight is required; so is the Wight of the known Gun, to a fourth Number, and so is that fourth to a fifth; and so is that fifth to the Weight required.

*Example 1.* Suppose a Brass Saker, whose Diameter is Inches 11.5 Tenths, and Weight 1900 Pounds; what will a Brass Gun weigh, whose Diameter is Inches 8.75 Parts? *Answer* 837.5 Pounds. For it is thus:

1. By Gunter's Scale with Compasses,

The Extent from the Diameter 11.5 to the Diameter 8.75, being laid three Times from the Weight 1900, will reach to 837.5 Pounds, the Weight of the Gun required. And,

2. By the Sliding Gunter.

Set the Diameter 11.5, against the Diameter 8.75: then against the Weight 1900 on the First, is 1445; on the

the Second ; and against 1445 on the First, is 1100 on the Second Also against 1100 on the First, is 837.5 Pounds, the Weight required, on the Second.

**P R O B. II.** *Having the Diameter and Weight of one Piece of Ordnance, and the Diameter of another Piece of another Metal given ; to find the Weight of the last, it being of the same Shape with the former.*

The **R U L E** is thus ;

1. **F I N D** the Weight of the Piece as if it had been of the same Metal as the propounded Piece by the last Problem, in Page 204 : Then,

2. Consider the Proportional Weights of Metals, which are known by the following Table of specific Gravity, estimated from the latest and most approved Experiments.

Cast Lead is to	Cast Brass	} as 11.26 is to	8.208
	Cast Iron		7.135
	Marble		2.7
	Flint Stone		2.621
Cast Iron is to	Cast Brass	} as 7.135 is to	8.208
	Marble		2.7
	Flint Stone		2.621

The Specific Gravity of *English* Pebble is 2.696, which is heavier than Flint Stone, and very near the Weight of Marble ; Pebble Stone is 2.601 ; *Portland* Stone 2.57, and Common Stone 2.5.

3. Having the Weights of both Pieces in one Sort of Metal, you must then Proportion their Weight according to their different Metals, by the Proportional Numbers of those Metals, and then it is done.

*Example 2.* If a Brass Saker of Inches 11.5 Tenths Diameter, weight 1900 Pounds ; what will an Iron Gun (of the same Shape) weigh, whose Diameter is Inches 8.75 Parts ? *Answer*, 728 Pounds. The Operation is thus :

1. I find by Prob. I. in Page 204, that a Brass Piece of Inches 8.75 Parts Diameter, will weigh 837.5 Pounds ; but because this Piece is Iron, and the Proportion of Brass to Iron (as abovesaid) is as 8.208 is to 7.135 ; therefore say,

2. As

2. As 8.208 is to 7.135, so is 837.5 to 728 Pounds, the Weight of the Iron Gun required.

**PROB. III.** *By knowing the Allowance of Powder for one Gun, to find how much of the same Powder is requisite for another Gun.*

### The R U L E.

**A**S the Diameter of the Bore of the Gun, whose Allowance is known, is to the Diameter of the Gun, whose Allowance is required; so is the Allowance given, to a fourth Number, and so is that fourth, to a fifth, and so is the fifth, to the Allowance required.

But note; here it is understood that both Guns are alike fortified, that is, that they shall have the same Proportion in Weight and Thickness of Metal.

*Example 3.* If a Saker of Inches 3.5 Tenths Bore require 4 Pounds of Powder, what will a Demi-Cannon of Inches 6.5 Tenths Bore require? *Answer*, Pounds 25.62 Parts. For it is thus:

As 3.5 is to 6.5, so is 4 to 7.44; and so is 7.44 to 13.80; and so is 13.80 to Pounds 25.62 Parts, the Weight of Powder for the Demi-Cannon, in Proportion to the given Saker. But suppose the Weight of the Saker to be 1600, and the Weight of the Demi-Cannon 6000; what Allowance of Powder must it then have?

I. By Problem I. Find the Weight of the Demi-Cannon in Proportion to the Saker's Weight, which is thus:

1. As 3.5 is to 6.5, so is 1600 to 1297; and so is 2971 to 5517, and so is 5517 to 10246 Pounds, the Weight of the Demi-Cannon, requiring Pounds 25.62 Parts of Powder for its Loading. But seeing its Weight is supposed to be 6000, say,

2. As 10246 is to 6000, so is 25.62 to Pounds 15, the due Allowance of Powder for the Demi-Cannon of Inches 6.5 Tenths Bore, weighing 6000 Pounds, at the Rate of a Saker Inches 3.5 Tenths Bore weighing 1600 Pounds, and requiring four Pounds of Powder.

P R O B.

**PROB. IV.** *Having the Diameter and Weight of one Bullet, and the Diameter of another Bullet given, to find the Weight of the latter.*

### The R U L E.

**T**HE Weight of Bullets (of the same Metal) are in Triplicate Proportion of their Diameter, and wrought by the Directions in Problem X. of the first Uses of the Gunter, in Pages 188 and 189.

*Example 4.* If an Iron Bullet 4 Inches Diameter weigh 9 Pounds; what will an Iron Bullet of 6 Inches Diameter weigh? *Answer,* Pounds 30.375 Parts. For it is thus;

As 4 is to 6, so is 9, to 13.5, and so is 13.5 to 20.25; and so is 20.25 to Pounds 30.375 Parts.

**PROB. V.** *Two Bullets, equal in Diameter, but of different Metals; by the Diameter and Weight of the one, to find the Weight of the other.*

### The R U L E.

**1.** **A**S the Proportion of one Metal is to the other, so is the Weight of the given Bullet to the Weight of the Bullet required.

*Example 5.* Suppose an Iron Bullet of 6 Inches Diameter, and weigh Pound 30.375 Parts; what will a Flint Stone Bullet of the same Diameter weigh? *Answer,* Pounds 11.158 Parts. The Operation is thus;

By Problem II. of Gunnery (in Page 205) the Proportion of Iron to Flint Stone is as 7.135 is to 2.621: therefore it is,

As 7.135 is to 2.621, so is 30.375 to Pounds 11.158 Parts, the Weight of the Stone Bullet.

**P R O B.**

P R O B. VI. *Having the Diameter and Weight of a Bullet of one kind of Metal, and the Diameter of any Bullet of any other given, to find the Weight of the latter.*

The R U L E.

1. **F**IND the Weight of it (by Problem IV.) as if it was the same Metal.
2. Then find its Weight according to the Proportion of the Metals by the late *Problem*, and it is done.

*Example 6.* If an Iron Bullet 4 Inches Diameter, weigh 9 Pounds; what is the Weight of a Leaden Bullet 6 Inches Diameter? *Answer*, Pounds 47.93 Parts; according to the following Operation:

1. As 4 is to 6, so is 9 to 13.5; and so is 13.5 to 20.25; and so is 20.25 to Pounds 30.375 Parts, if it had been Iron, but as it is Lead, say,

2. As 7.135 is to 11.26, so is 30.375 to Pounds 47.93 Parts, the Weight being Lead.

V. *The Use of Gunter's Scale in Navigation; and first in Plane Sailing.*

C A S E. I.

*The Course and Distance sailed being given; to find the Difference of Latitude and Departure from the Meridian.*

To do this, the Proportions are these:

**A**S Radius is to the Distance, so is the Sine of the Course to the Departure from the Meridian.

2. As Radius is to the Distance, so is the Sine Complement of the Course to the Difference of Latitude.

*Note.* The Radius according to the Nature and the Proportion, may be any of these.

8. Points

8 Points	} on the Line of	{	Sine Rhumbs.
4 Points			Tangent Rhumbs.
90 Degrees			Sines.
45 Degrees			Tangents.

And for Conveniency, that each Proportion may stand in one Line.

Let S.	} stand for	{	Sine
S. c.			Sine Complement
T.			Tangent
T. c.			Tangent Complement
Crs.			Course
Dist.			Distance sailed
Diff. Lat.			Difference of Latitude
Dep.			Depart. from the Meridian.

*Example.* If a Ship Sails SW. by S. 104 Minutes from Latitude 1d. 45m. North, I demand what Latitude she is in, and her Departure from the Meridian?

As S. 8 P. is to 104 M. so is S.  $\left\{ \begin{smallmatrix} 3 \\ 5 \end{smallmatrix} \right\}$  Points to  $\left\{ \begin{smallmatrix} \text{Dep. } 58 \text{ M.} \\ \text{Diff. Lat. } 86 \text{ M.} \end{smallmatrix} \right\}$

1. By Gunter with Compasses, thus;

The Extent from 8 Points on the Line of Sine Rhumbs, to 104 Min. (on the Line of Numbers) will reach the same Way from 3 Points (on the Line of Sine Rhumbs) to 58m. (on the Line of Numbers) which is the Departure from the Meridian; and the Compasses kept at the same Distance, will reach (the same Way) from 5 Points (on the Line of Sine Rhumbs) to 86 Minutes (on the Line of Numbers) which is the Difference of Latitude.

*Note;* The Course is 3 Points, because SW. by S. is 3 Points from the Meridian or South; and 5 Points is the Complement of the Course, because S.W by S. is 5 Points from the Parallel or West; understand the like in any other Course.

*By the Sliding Gunter, thus :*

Slide 104 min. on the Middle Piece, against 8 Points, on the Line of Sine Rumbs, on the lower outside Piece ; then against 3 Points on the first, is 58 Minutes on the second, the Departure from the Meridian, and against 5 Points on the first, is 86 Minutes on the second, the Difference of the Latitude.

	D.	M.
Latitude sailed from - - - - -	01 :	45 North
Difference of Latitude 86 Minutes, or	01 :	26 South
u. btract gives the Latitude required -	00 :	19 North

## C A S E II.

*The Course and Difference of Latitude being given, to find the Distance sailed, and the Departure from the Meridian.*

To do this, the Proportions are these :

1. As the Sine Comp. of the Course is to the Difference of Latitude, so is Radius to the Distance run.

2. As the Sine Complement of the Course is to the Difference of Latitude, so is the Sine of the Course to the Departure from the Meridian.

*Example.* Suppose a Ship sails N. N. E. from the Latitude of 2d. 15m. South, and then by Observation is in Latitude 1d. 22m. North ; what is her Distance sailed and Departure from the Meridian?

	D.	M.
Latitude sailed from - - - - -	02 :	15 South
Latitude by Observation - - - - -	09 :	22 North

Added, gives the Difference of Latitude 03 : 37 which reduced into Minutes by multiplying by 60, is 217 Min. Then ;

As S. 6 Pts. is to 217 M. so is S.  $\left\{ \begin{smallmatrix} 8 \\ 2 \end{smallmatrix} \right\}$  Pts. to  $\left\{ \begin{smallmatrix} 235 \\ 90 \end{smallmatrix} \right\}$  the Dist. the Dep

C A S E.



# C A S E III.

*The Course and Departure from the Meridian being given, to find the Distance run, and the Difference of Latitude.*

This is performed by these Proportions.

1. As the Sine of the Course is to the Departure from the Meridian, so is Radius to the Distance sailed.

2. As the Sine of the Course is to the Departure from the Meridian, so is the Sine Complement of the Course to the Difference of Latitude.

*Example.* If a Ship sails SE by E. from 1d. 10m. North Latitude, till her Departure be 92 Minutes, what is her Distance sailed, and Latitude she is in?

As S. 5 Pts. is to 92 M. so is S.  $\left\{ \begin{smallmatrix} 8 \\ 3 \end{smallmatrix} \right\}$  Pts. to  $\left\{ \begin{smallmatrix} 110 \text{ Dist.} \\ 61 \text{ Diff.L.} \end{smallmatrix} \right\}$   
D. M.

Latitude sailed from - - - - - 01 : 10 North  
Difference of Latitude 61 Minutes, or - 01 : 01 South

Subtracted, gives the Latitude the Ship is in 00 : 9 North

# C A S E IV.

*The Distance run, and Difference of Latitude being given, to find the Course and Departure from the Meridian.*

The Proportions are these :

1. **A**s the Distance sailed is to the Radius, so is the Difference of Latitude to the Sine Complement of the Course.

2. As the Radius is to the Distance sailed, so is the Sine of the Course to the Departure from the Meridian.

*Example.* Admit a Ship sails between the S. and W. 98 Leagues from the Lizard, in 49d. 57m. North Latitude, and then by Observation is in 46d. 27m. North Latitude, what is her Course and Departure from the Meridian?

O 2

D. M.

D. M.

Latitude sailed from \_\_\_\_\_ 49 : 57 North  
 Latitude by Observation \_\_\_\_\_ 46 : 27 North

The Difference of Latitude - - - - 03 : 30 or 70 L.

1. As 98 Leagues, is to Sine of 90 Degrees, so is 70 Leagues to Sine 45d. 30m. whose Complement 44d. 30m. is the Course from the South Westward, that is, South West nearest: Then,

2. As Sine 90 Degrees is to 98 Leagues, so is Sine 44d. 30m. to 68.4 Leagues, the Departure from the Meridian.

1. By *Gunter* with Compasses.

1. The Extent from 98 Leag. on the Line of Numbers, to 90 Degrees on the Line of Sines, will reach the same Way from 70 Leag. on the Line of Numbers, to 45 Deg. 30 Min. on the Line of Sines; which being subtracted from 90 Deg. leaves 44d. 30m. for the Course.

2. The Extent from 90 Degrees on the Line of Sines, to 98 Leagues, on the Line of Numbers, will reach from 44d. 30m. on the Line of Sines, to 68.4 Leagues, on the Line of Numbers, which is the Departure from the Meridian.

2. By the *Sliding Gunter*.

1. Bring 98 Leagues on the Line of Numbers on the middle Piece; against 90 Degrees on Line of Sines, on the out-side Piece; then right against 70 Leagues on the First, is 45 Deg. 30 Min. on the Second, which is the Complement of the Course, and subtracted from 90 Deg. gives 44d. 30m. which is near four Points from the South towards the West, or South West.

2. And as it now stands, against 44d. 30m in the Line of Sines on the outside Piece, is 68.4 Leagues in the Line of Numbers, on the middle Piece, which is the Departure from the Meridian.

C A S E V.

*The Distance run, and the Departure from the Meridian being given, to find the Course and Difference of Latitude.*

The

The Proportions are as follow :

1. **A**S the Distance sailed is to Radius ; so is the Departure from the Meridian, to the Sine of the Course.

2. As Radius, is to the Distance sailed, so is the Sine Complement of the Course, to the Difference of Latitude.

*Example.* A Ship sails 354 Minutes between the North and East from 1d. 19m. South Latitude, until her Departure from the Meridian be 150m. what is her Course, and what Latitude is she in ?

1. As 354 Minutes is to Sine 90d. so is 150 Minutes to Sine 25d. so that the Course is N. Eastward, or NNE. a quarter East.

2. As S. 90d. Degrees is to 354 Minutes, so is Sine 65 Degrees, to 323 Minutes, the Difference of Latitude.

D. M.

Latitude sailed from is - - - - - 01 : 19 South

The Difference of Lat. 323 Minutes, or 05 : 23 North

Subtracted, gives the Latitude the Ship is in 04 : 04 North  
so that the Ship hath crossed the Equator.

# C A S E VI.

*The Difference of Latitude and Departure from the Meridian being given, to find the Course and Distance run.*

To do this, these are the Proportions :

1. **A**S the Difference of Latitude is to the Departure from the Meridian, so is Radius, to the Tangent of the Course.

2. As the Sine of the Course is to the Departure from the Meridian, so is Radius to the Distance sailed.

*Example.* Sailing between the North and West, from a Port in 1d. 59m. South Latitude, and then arriving at another Port which is in 3d. 8m. North Latitude, and 209 Minutes to the Westward of the first Port. I demand the Course and Distance from the first Port to the second.

O 3

D. M.

D. M.

Latitude of the first Port - - - - 1 : 59 South

Latitude of the second Port - - - - 3 : 08 North

Added, gives the Difference of Latitude 5 : 07 or 307m.

1. As 307 Min. is to 209 Min. so is Tangent 45 Deg. to Tangent 34 Deg. 15 Min. the Course North Westward, or NW. by N. nearest.

2. As S. 34 Degrees 15 Minutes, is to 209 Minutes, so is S. 90 Degrees to 307 Minutes, the Distance between the two Ports.

1. By *Gunter* with Compasses, thus :

1. The Extent from 307 Min. to 209 Min. on the Line of Numbers will reach from 45 Deg. on the Line of Tangents (that now being the Radius) to 34 Degrees 15 Min. on the same Line of Tangents, which is the Course from the Meridian.

*Note,* When the Difference of Latitude is greatest, the Course is less than 45 Degrees from the Meridian.

But when the Departure from the Meridian is greatest, the Course is more than 45 Degrees from the Meridian.

2. The second Canon or Proportion for the Distance run, is wrought as in the second and third Case, in Pages 210 and 211.

2. By the *Sliding Gunter*, thus :

1. In this Case place the middle Piece in such a Manner, that a Tangent Line may slide against a Tangent Line, and also Numbers against Numbers: Then bring 307 Min. on the Line of Numbers on the middle Piece, against 209 Min. on the Line of Numbers on the outside Piece, and against 45 Degrees on the Line of Tangents, on the middle Piece, will be 34 Degrees 15 Minutes on the Tangents on the outside Piece, which is the Course required.

2. For the Distance, the Manner of working is the same as has been shewn in Cases First, Second, and Third.

To resolve a Traverse by *Gunter's Scale*.

*Example 1.* A Ship in 40 Degrees North Latitude, and 5 Degrees 14 Minutes West Longitude, sails first S. E. by S. 68 Minutes, then S. W. by W. 35 Minutes, and then W. N. W. 75 Minutes: I demand the Course and Distance from the first Place of Departure, and what Latitude and Longitude she is in?

To do this, First find the Difference of Latitude and Departure from the Meridian, for each several Course, as directed in Case I. of Plane Sailing, in Pages 208 and 209.

2. Collect the several Differences of Latitude into two Sums, viz the Northing into one, and the Southing into another, and in like Manner, the several Departures either East or West, taking the Difference of the Northing and Southing, for the Difference of Latitude, and the Difference of the Easting and Westing for the Departure from the Meridian.

3. Having now the Difference of Latitude and the Departure from the Meridian known, the Course and Distance may be found in the Sixth Case of Plane Sailing, in Pages 213 and 214.

4. The Difference of Longitude may be found by this Proportion.

As the Sine Complement of the Middle Latitude is to the Departure from the Meridian, so is Radius to the Difference of Longitude. See the Work following.

- |  |   |                       |       |
|--|---|-----------------------|-------|
| 1. Course, as S. 8 Pts. is to 68, so is S. | { | 3 to $37\frac{8}{10}$ | E.ing |
|  |   | 3 to $56\frac{7}{10}$ | S.ing |
| 2. Course, as S. 8 Pts. is to 35, so is S. | { | 5 to $45\frac{7}{10}$ | W.ing |
|  |   | 3 to $30\frac{6}{10}$ | S.ing |
| 3. Course, as S. 8 Pts. is to 75, so is S. | { | 6 to $69\frac{8}{10}$ | W.ing |
|  |   | 2 to $28\frac{7}{10}$ | N.ing |

Course

Courses.	Dist.	Diff. Lat.		Departure.	
		North	South	East	West
1. S.E. by S.	68		56.5	37.8	
2. S.W. by W.	55		30.6		45.7
3. W.N.W.	75	28.7			69.3
		28.7	87.1	37.8	115.0
			28.7		37.8
		Diff. Lat.	58.4		77.2

Dep

3. Then; as Min. 58.4 is to Min. 77.2, so is T. 45d. to T. 52d. 54m. the Course from the South towards the West, that is, S. W. three quarters W. almost; And again,

As S. 52d. 54m. is to min. 77.2. so is S. 90d. to 96,8 Minutes, the Distance from the first Place of Departure.

D. M.

Latitude failed from ———— 40 : 00 North ;  
The Diff. of Latitude min. 58.4 or ———— 00 : 58 Southerly ;

Subtracted, gives the Lat. the Ship is in 39 : 02 North ;

Therefore the middle Latitude is 39 : 31  
Subtracted from ———— 90 : 00

Gives the Comp. of the middle Lat. 50 : 29

4. As S. 50d. 29m. is to Min. 77.2, so is S. 90d. to 101.1m. the Difference of Longitude.

D. M.

The Longitude failed from is ———— 05 : 14 West.  
The Difference of Longitude ———— 01 : 41 West.

Added, gives the Longit. the Ship is in 06 : 55 West.

*Example 2.* A Ship in 41d. 30m. North Latitude, and 10d. 20m. East Longitude, fails these several Courses and Distances, viz, S. E. by S. 52 Minutes, then S.S.W. 63 min.

63 Minutes, E. by N. 47 Minutes, N. by E. half E. 35 Minutes, NNW. a quarter W. 47 Min. WNW. 73 Min. I demand the Course and Distance from the first Place of Departure, also the Latitude and Longitude the Ship is in?

1. For the doing of which, observe the following Work.

	M.	Points.	M.
1	52	3	28.9 E.
		5	43.2 S.
2	63	2	24.1 W.
		6	58.2 S.
3	47	7	46.1 E.
		1	9.2 N.
4	35	$1\frac{1}{2}$	10.2 E.
		$6\frac{1}{2}$	33.5 N.
5	47	$2\frac{1}{2}$	20.1 W.
		$5\frac{3}{4}$	42.5 N.
6	73	6	67.4 W.
		2	27.9 N.

2. Then, to collect the several Northings, Southings, Eastings, and Westings into one, see the following Table; whereby you have the Difference of Latitude and Departure from the Meridian.

Courses.	Dist.	Diff. Lat.		Departure	
		North	South	East	West
1. S. E. by S.	52		43.2	28.9	
2. S. S. W.	63		58.2		24.1
3. East by North	47	9.2		46.1	
4. N. by E. $\frac{1}{2}$ E.	35	33.5		10.2	
5. N. N. W. $\frac{1}{4}$ W.	47	42.5			20.1
6. W. N.W.	73	27.9			67.4
		113.1	101.4	85.2	111.6
		101.4			85.2
Difference Latitude		11.7	Departure		26.4

3. Now

Now, having the Difference of Latitude and Departure from the Meridian known, the direct Course and Distance is thus found.

As 11 7 Minutes is to 26.4 Minutes, so is T. 45d. to T. 66d. 06m. the Course North Westerly, or W. N. W. because the North and West Columns are the greatest.

Here observe the Course is more than 45 Degrees from the Meridian, because the Departure is more than the Difference of Latitude, according to the Note in the 6th Case of Plane Sailing, in Page 214. Then for the Distance, say,

As S. 66d. 06m. is to 26.4 Minutes, so is 90 Degrees to Minutes 28.88, the Distance from the first Place of departing.

	D.	M.
Latitude sailed from - - - - -	41	: 30
The Difference of Latitude m. 11.7. or	00	: 12 North
	<hr/>	
Added, gives the Lat. the Ship is in -	41	: 42 North
	<hr/>	
And the middle Latitude is - - - - -	41	: 36
Subtracted from - - - - -	90	: 00
	<hr/>	
Gives the Comp. of the Middle Latitude.	48	: 24

Then to find the Difference of Longitude, say,

As S. 48d. 24m. is to 26.4 m. so is S. 90d. to 35.31 min. the Difference of Longitude.

	D.	M.
The Longitude sailed from is - - -	10	: 20 East
The Difference of Longitude 35.31 min. or	00	: 35 West
	<hr/>	
Subtract, it gives the Long. the Ship is in	09	: 45 East

*Secondly,*



Secondly, The Use of Gunter's Scale in Mercator's Sailing.

# C A S E I.

The Latitude and Longitude of two Places being given, to find the Course and Distance between them.

*Example.* I demand the Course and Distance from the Lizard to Barbadoes? Latitudes and Longitudes of those Places being supposed as follows:

		d.	m.			d.	m.
Lizard	} Lat.	49	57	North	} Long.	5	14 W.
Barbadoes		12	58	North		58	50 W.

The Diff. of Lat.  $\begin{array}{r} 36 \\ 60 \end{array}$  59 South, Diff. Long.  $\begin{array}{r} 53 \\ 60 \end{array}$  36 W.

Minutes 2219

Minutes 3216

To answer the Question, the Proportions are these.

1. As the Meridional Difference of Latitude, is to the Difference of Longitude, so is Radius to the Tangent of the Course.

2. As the Sine Complement of the Course is to the Difference of Latitude, so is Radius to the Distance of the two Places.

The Meridional Difference of Latitude is thus found:

Extend the Compasses on the Meridional Line, from one Latitude to the other; that Extent measured on the Equinoctial Line (the next Line adjoining to the Meridional Line marked EP.) gives the Meridional Difference of Latitude.

Thus the Extent from Latitude 49d. 57m. to Latitude 12d. 58m. on the first, being measured on the latter, is deg. 44  $\frac{25}{60}$  or 44d. 45m. or 2685 Minutes, the Meridional Difference of Latitude: Then say,

As

As 2685 M. is to 3216 M. } so is T. 45d. to T. 50d. 09m.  
 Or, As 44d.  $\frac{71}{100}$  is to 53d.  $\frac{10}{100}$  }  
 the Course from the South Westward, or S. W. 5 Degrees  
 9 Minutes Westerly: And again,  
 As S. 39d. 51m. is to 2219m. so is S. 90d. to 3463m.  
 Or, as S 39d. 51m. is to 36d.  $\frac{231}{1000}$ , so is Sine 90d. to  
 57d.  $\frac{71}{100}$  or 57d. 43m. equal to 3463 Minutes.

## C A S E II.

*Both Latitude and Course being given; to find the Distance  
 and Difference and Longitude.*

The Proportions are these :

1. **A**S the Sine Complement of the Course is to the  
 Difference of Latitude, &c. as before in the Second  
 Case of Plane-Sailing, to find the Distance and Departure  
 from the Meridian, in Page 210.

2. As the Sine Complement of the middle Latitude is to  
 the Departure from the Meridian, so is the Radius to the  
 Difference of Longitude.

Or thus; as the Sine Complement of the Course is to  
 the Meridional Difference of Latitude, so is the Sine of the  
 Course to the Difference of Longitude.

*Example.* Admit from the *Lizard* in 49 Deg. 57 Min,  
 North Latitude, and Longitude 5d. 14m. West, we made  
 (when Leeway, Variation, &c. were allowed for) our  
 Course to be South 39 Deg. Westerly; and then by Obser-  
 vation was in 44d. 58m. North Latitude; I demand her  
 Distance run, and what Longitude she is in.

Latitude failed from ————— 49d. : 57m. North

Latitude by Observation ————— 44d. : 58m. North

Subtracted, is the Diff. of Lat. ————— 04d. : 59m. Southerly  
60

Minutes 299

The Middle Latitude is ————— 47d. : 27m.

Subtract from ————— 90d. : 00m.

Comp. of the Middle Latitude ————— 42d. : 33m.

1. As S. 51d. is to 299m. so is S.  $\left\{ \begin{smallmatrix} 90 \\ 39 \end{smallmatrix} \right\}$  d. to  $\left\{ \begin{smallmatrix} 385 \\ 242 \end{smallmatrix} \right\}$  Dist. Depart

2. As 42d. 33m. is to 242 Minutes, so S. 90d. to 358 Minutes, the Difference of Longitude. Or thus, the Exten from 49d. 57m. on the Meridian Line, 44d. 58 m. measured on the Line of equal Parts is 7d.  $\frac{1}{4}$  or 7d. 24m. or 444 Minutes, for the Meridional Difference of Latitude: Then,

As 51d. is to 444 Minutes, so is S. 39d. to 358m. Or thus;

As 299 Minutes is to 242 Minutes, so is 444 Minutes to 358 Minutes, as before; which is the Difference of Longitude.

The Longitude failed from ————— d. m. 05 : 14 West

The Difference of Longitude 358 min. or ————— 05 : 58 West

Added, gives the Longitude the Ship is in 11 : 12 West

C A S E III.

*Both Latitudes and Distance run being given, to find the Course and Difference of Longitude.*

To perform this, the Proportions are these:

1. **A**S the Distance failed is to Radius, so is the Difference of Latitude to the Sine Complement of the Course, as in the fourth Case of Plane Sailing, in Page 211, by which Case also you may find the Departure from the Meridian, or Meridian Distance.

2. **A**

2. As the Sine Complement of the middle Latitude is to the Departure, so is the Radius to the Difference of Longitude: Or thus;

As the Difference of Latitude is to the Departure from the Meridian, so is the Meridional Difference of Latitude to the Difference of Longitude.

*Example.* A Ship in 46d. South Latitude, and 1d. 15m. West Longitude, sails 100 Leagues North Eastward, and then by Observation is in Latitude 42d. South: I demand her Course, Departure from the Meridian, and the Longitude she is in?

Latitude sailed from is - - - 46d. South  
Latitude by Observation is - - 42d. South

Subtracted, gives the Diff. of Lat. 4d. or 80 Leagues N.

The middle Latitude is - - - 44d. whose Comp. is 46d.

1. As 100 Leagues is to S. 90d. so is 80 Leagues to S. 53 Deg. 15 Min. the Complement of the Course; so that the Course is 36 Deg. 45 Min. North Eastward, or N.E. by N. a Quarter E. And then again,

As S. 90d. is to 100 Leagues, so is S. 36d. 45m. to 60 Leagues, the Departure from the Meridian.

As S. 46 Deg. is to 60 Leagues, so is S. 90 Deg. to 83 Leag. the Difference of Longitude: Or thus: The Extent from 46d. to 42d. on the Meridional Line makes 5d.  $\frac{15}{60}$ , or 110 Leagues on the equal Parts, which is the Meridional Diff. of Latitude; and then it is,

As 80 leag. is to 60 leag. so is 110 leag. to 83 leag. } diff. long.  
Or, as 4d. is to 3d. so is 5d.  $\frac{15}{60}$  to 4d.  $\frac{15}{60}$  }  
Longitude sailed from is - - - 1d. : 15m. West  
The Difference of Longitude 83 leag. or 4d. : 09m. East

Subtracted gives the Long. the Ship is in 2d. : 54m East

## C A S E IV.

*Both Latitudes and Departure from the Meridian being given,  
to find the Course, Distance run, and Differ. Long.*

1. **T**HE Course and Distance run is found by the sixth Case of Plane Sailing in Page 213.

2. The Difference of Longitude is found as in the second, third, or fourth Case in *Mercator*.

*Example.* A Ship in 33 Degrees North Latitude, and 178 Degrees West Longitude, sails South Westward until she has departed from the Meridian 58 Leagues, and then she is in Latitude 28d. 36m. North. I demand her Course, Distance run, and what Longitude she is in?

d. m.

Latitude sailed from — 33 : 00 North

Latitude the Ship is in — 28 : 36 North

The Difference of Latitude 04 : 24 or 88 Leagues

The Middle Latitude is—30 : 48 Comp. 59d. 12m.

1. As 88 Leagues is to 58 Leagues, so is T. 45 Deg. to T. 33d. 20m. which is the Course South Westerly, or or SW. by S.

2. As S 33d. 20m. is to 58 Leagues, so is S. 90d. to 105 Leagues, the Distance sailed.

3. The Meridional Difference of Latitude 5 Deg.  $\frac{1}{4}$  or 5 Deg. 9 Min. or 103 Leagues is found as before directed.

4. As  $\left\{ \begin{array}{l} \text{S. } 59. 12\text{m.} \\ \text{88 Leag.} \end{array} \right\}$  is to 58 Leag. so is  $\left\{ \begin{array}{l} \text{S. } 90 \text{ Deg.} \\ \text{103 Leag.} \end{array} \right\}$  to 67 Leagues the Difference of Longitude.

5. Longitude sailed from - - - 178 : 00 West

The Difference of Longitude 67 Leag. or 03 : 21 West

Added, the Sum is ————— 181 : 21

Which subtract from ————— 360 : 00

Remainder is the Longitude the Ship is in 178 : 39

C A S E

## C A S E V.

*One Latitude, Course and Distance run being given, to find the other Latitude, and Difference of Longitude.*

1. **T**HE Difference of Latitude and Departure from the Meridian is found by the first Case of Plane Sailing (in Pages 208 and 209) and consequently the other Latitude.

2. The Difference of Longitude is found as before in the second or third Case of *Mercator*.

*Example.* If a Ship sails SE. by S. 120 Leagues from a Port in 53d. 30m. North Latitude, and 2d. 15m. West Longitude, what Latitude and Longitude is she in?

As S. 8 Points is to 120 Leagues, so is S. 5 Points to 100 Leagues, the Difference of Latitude.

And as S. 8 Points is to 120 Leagues, so is S. 3 Points to 67 Leagues the Departure from the Meridian.

D. M.

Latitude sailed from ————— 53 : 30 North  
The Diff. of Latitude 100 Leagues, or ——— 05 : 00 South

Subtracted, gives the Lat. the Ship is in — 48 : 30 North

And the Middle Latitude is ——— 51 Comp. 39d.  
The Meridional Diff. Lat. is 8d. or 160 Leagues.

As { S. 39d. } is to 67 Leag. so is { S. 90d. } to  
{ 100 Leagues } { 160 Leagues }

107 Leagues the Difference of Longitude.

D. M.

Longitude sailed from is ————— 02 : 15 West  
The Diff. of Longitude 107 Leagues, or — 05 : 21 East

Subtracted, gives the Longitude she is in — 03 : 06 East

So that the Ship hath crossed the first Meridian.

G. A S E

C A S E VI.

*Sailing in a Parallel, to find the Difference of Longitude.*

To do this, the Proportion is thus ;

**A**S the Sine Complement of the (Parallel or) Latitude is to the Distance sailed East or West, so is Radius to the Difference of Longitude.

*Example.* If a Ship sails West 390 Minutes; in the Latitude of 50d. 10m. and departs from 2d. 45m. East Longitude, I demand what Longitude the Ship is now in ?

As S. 39d. 50m. is to 390m. so is 90d. to 610m. the Difference of Longitude.

	d.	m.
Longitude sailed from, is	2	45 East
The Difference of Longit. 610 min, or	10	10 West

Subtracted, gives the Long. the Ship is in — 7 : 25 West

C A S E VII.

*The Diff. of Longitude of two Places in one Parallel or Latitude being given, to find their Distance in that Parallel.*

**T**HE Proportion is thus ; as Radius is to the Difference of Longitude, so is the Sine Complement of the Latitude to the Distance in that Parallel.

*Example 1.* Suppose Cape St. Vincent in Portugal and Cape Henry in Virginia, both in 37 Deg. North Latitude, and their Longitude as hereunder, what is their Distance in that Parallel ?

Cape St. Vincent	Longitude	{ 09 : 06 West.
Cape Henry		{ 76 : 23 West.

Subtracted, gives the Diff. Long. 67 : 17 or 40<sup>37</sup> Minutes

Latitude of both Places is nearly ———— 37 Deg. North

Subtract from ———— ———— ———— 90

Remains Complement of the Latitude ——— 53

P

2. As

2. As S. 90 Degrees is to S. 53 Degrees, so is 67  $\frac{1}{3}$  equal to 67d. 17m. to 53  $\frac{1}{3}$  or 53d. 44m. or 3224m. the Distance required. Or thus,

2. As 90 Degrees is to S. 53 Degrees, so is 4037 Minutes to 3224m. the Distance in the Parallel, as above.

*Example 2.* Suppose two Ships under the Equinoctial, 100 Leagues asunder, and each sails North till both come into Latitude 60 Degrees, how far are they now asunder? *Answer,* 50 Leagues. For,

As S. 90 Degrees is to S. 30 Degrees, so is 100 Leagues to 50 Leagues, the Distance required.

## C A S E VIII.

*To find how many Minutes or Miles make a Degree of Longitude in any Parallel of Latitude.*

### The R U L E.

**A**S Radius is to the Sine Complement of the Latitude, so is 60 Min. (a Degree on the Equinoctial) to the Minutes making a Degree of Longitude in the Parallel desired.

*Example.* In the Latitude of 50 Degrees, I demand how many Minutes of Easting and Westing make a Degree of Longitude? *Answer,* 38  $\frac{1}{2}$  Minutes. For,

As S. 90 Deg. is to S. 40 Deg. so is 60 Min. to Min. 38.5 or 38 and a half, making one Degree of Longitude in Latitude 50 Degrees.

This may be done by the Plane-Scale thus :

Take the given Latitude from the Chords, and measure it on the Line M. L. (which is Miles of Longitude) and it will answer your Desire : As, for Instance, take 50 Degrees from the Chords, and measure it on the Scale M. L. and it sheweth 38 Min. and a half, the same as before.

VI, *The*



VI. The Use of Gunter's Scale in Astronomy.

PROBLEM I. *The Sun's Place in the Ecliptic, and his greatest Declination being given, to find his Right Ascension and present Declination.*

To perform this, observe the following Proportions :

1. **A**S Radius is to the Sine Complement of the Sun's greatest Declination, so is the Tangent of the Longitude (from the nearest Equinoctial Point) to the Tangent of his Right Ascension from the said Point.

*The Names and Characters of the 12 Signs.*

♈ Aries	} North Signs	♎ Libra	} South Signs
♉ Taurus		♏ Scorpio	
♊ Gemini		♐ Sagittarius	
♋ Cancer		♑ Capricornus	
♌ Leo		♒ Aquarius	
♍ Virgo		♓ Pisces	

Note 1. The Sun's greatest Declination is 23 Degrees 29 Minutes.

Note 2. The Beginning of *Aries* and *Libra* are the two Equinoctial Points.

Note 3. This Proportion (above) finds the Sun's Right Ascension only when he is in the first Quarter of the Ecliptic, that is, ♈, ♉, ♊. But when he is in the second Quarter, ♋, ♌, ♍, subtract from 180 Deg. and when in ♎, ♏, and ♐, add to it 180 Degrees, and in the last Quarter ♑, ♒, and ♓, subtract what is found by this Operation, from 360 Degrees, and you have the Sun's Right Ascension from ♈; for any Place in the Ecliptic desired.

2. As Radius is to the Sine of the Sun's Longitude from the nearest Equinoctial Point, so is the Sine of the Sun's greatest Declination to the Sine of his present Declination.

*Note,* The Sun being in  $\gamma$ ,  $\delta$ ,  $\pi$ ,  $\varpi$ ,  $\Omega$ , and  $\mathfrak{m}$ , his Declination is North, but in  $\epsilon$ ,  $\mathfrak{m}$ ,  $\rho$ ,  $\gamma\rho$ ,  $\mathfrak{u}$ , and  $\mathfrak{x}$ , it is South.

*Example.*

*When the Sun's Place in the Ecliptic is  $\delta$  24d 15m What is his Right Ascension and Declination?*

The Sun being in  $\delta$  24 Degrees 15 Minutes, his Longitude from the nearest Equinoctial Point (being now the beginning of  $\gamma$ ) is 54 Degrees 15 Minutes, and the Complement of his greatest Declination is always 66 Degrees 31 Minutes. Then it follows :

1. As S. 90 Degrees is to S. 66 Degrees 31 Minutes, so is Tangent 54 Degrees 15 Minutes, to Tangent 51 Degrees 52 Minutes, the Sun's Right Ascension (from the Beginning of  $\gamma$ ) required.

1. By *Gunter* with *Compasses*.

The Extent from Sine 90 Degrees, to Sine 66 Degrees 31 Minutes will reach from Tangent 54 Degrees, 15 Min. to Tangent 51 Degrees 52 Min. the Sun's Right Ascension.

By the *Sliding Gunter*.

1. Let the middle Piece be so put in, that Sines may slide against Sines, and Tangents against Tangents.

2. Then bring 90 Degrees in Sines (on the outside Piece) against 66 Degrees 31 Minutes in Sines (on the middle Piece) then against 54 Degrees 15 Min. in Tangents (on the middle Piece) is 51 Deg. 52 Min. in Tangents (on the outside Piece) the Right Ascension as above.

This Proportion being to be wrought on Sines and Tangents, jointly, I thought it necessary to express the Manner of its Operation on both Sorts of *Gunters*, that the Learner might see how it agrees with the General Rule given at the Beginning of this Discourse of the *Gunter* in Pages 177 and 178, but shall wave it in the rest, and only write the Proportion in Words and Figures, according to the particular Example as follows, for the Sun's Declination.

2. As S. 90 Degrees is to S. 54 Deg. 15 Min. so is S. 23 Deg. 29 Min. to S. 18 Deg. 52 Min. the Sun's Declination North, increasing.

## P R O B L E M II.

*The Latitude of a Place, and the Sun's Declination being given, to find his Amplitude and Ascensional Difference, and consequently his Rising and Setting, and the Length of the Day and Night.*

To perform this Problem, the Proportions are these :

1. **A**S the Sine Complement of the Latitude is to Radius, so is the Sine of the Sun's Declination to the Sine of his Amplitude.

*Note,* The Amplitude and Declination are always of one Kind ; that is, both North, or both South.

2. As the Tangent Complement of the Latitude is to the Tangent of the Sun's Declination, so is Radius to the Sine of his Ascensional Difference.

*Note 1.* The Ascensional Difference (being reduced into Time, by allowing 15 Degrees for one Hour, and then) added to, and subtracted from 6 Hours, the one is Sun-rising, and the other Sun-setting.

*Note 2.* If the Latitude and Declination are both North or both South, the Sun riseth before, and sets after Six of the Clock ; but if one be North, and the other South, the contrary.

*Note 3.* If the Sun's rising and setting be doubled severally, the former is the Length of the Night, and the latter is the Length of the Day.

*Note 4.* By this Problem the Tables of Amplitudes and Semidiurnal Arches, &c. in this Book were calculated.

*Example.* The Latitude being 51 Deg. 32 min. North, Sun's Declination 23 Deg. 29 Min. North, I demand his Amplitude and Ascensional Difference ; also his Rising, Setting, and Length of the Day and Night.

*Answ.* Sun's Amplitude is  $\begin{matrix} \text{d.} & \text{m.} \\ 39 & : & 50 \end{matrix}$  Ascen. Diff.  $\begin{matrix} \text{d.} & \text{m.} \\ 33 & : & 10 \end{matrix}$

Sun-setting } is Hours { 8 : 13 Leng. of Day 16 : 26  
 Sun-rising } { 3 : 47 Leng. of Night 7 : 34

For (by the preceding Proportions,)

1. As S. 38d. 28m. is to S. 90d. so is S. 23 deg. 29 min. to 39 deg. 50 min. the Amplitude North, because the Declination is North, that is, the Sun riseth East 39 deg. 50 min. Northerly, and setteth West 39d. 50m. Northerly.

2. As T. 38 Deg. 28 Min. is to T. 23 Deg. 29 Min. so is S. 90 Deg. to S. 33 Deg. 10 Min. the Ascensional Difference, which being reduced into Time, is 2 Hours 13 Minutes, and added to 6 Hours, is 8 Hours 13 Minutes for Sun-setting; which doubled is 16 Degrees, 26 Minutes the Length of the Day.

Again, 2 Hours 13 Minutes subtracted from 6 Hours, is 3 Hours 47 Minutes for Sun-rising; which doubled is 7 Hours 34 Min. the Length of the Night.

### P R O B L E M III.

*The Latitude of a Place, and the Sun's Declination being given, to find his Altitude and Azimuth at Six of the Clock.*

*To solve this, say,*

1. **A**S Radius is to the Sine of the Latitude, so is the Sine of the Sun's Declination to the Sine of his Altitude at Six of the Clock.

2. As Radius is to the Sine Complement of the Latitude, so is the Tangent of the Sun's Declination to the Tangent of his Azimuth (from the East or West) at Six of the Clock.

*Note,* The Azimuth is from the East at Six in the Morning, and from the West at Six in the Afternoon, Northerly, in North Latitude, but Southerly in South Latitude.

*Example,* In 51d. 32m. North Latitude, the Sun's Declination being 23d. 29m. North, what is his Altitude and Azimuth at Six of the Clock.

*Answer,*

*Answer,* His Altitude is 18d. 11m. and his Azimuth East 15d. 7m. Northerly, or 74d. 53m. North Easterly; or Westerly; For;

1. As 90d. is to S. 51d. 32m. so is S. 23d. 29m. to S. 18d. 11m. the Altitude at Six of the Clock.

2. As S. 90d. is to S. 38d. 28m. so is T. 23d. 29m. to T. 15d. 07m. the Azimuth at Six; that is, 74d. 53m. North Easterly at Six in the Morning, but North Westerly in the Afternoon, (as by the preceding Proportions.)

# PROBLEM IV.

*The Latitude of a Place and Sun's Declination being given, to find his Altitude, and the Hour of the Day, when he is in East or West.*

To perform this, the Proportions are these;

1. **A**S the Sine of the Latitude is to Radius, so is the Sine of the Sun's Declination to the Sine of its Altitude, when East or West.

2. As the Tangent of the Latitude is to the Tangent of the Sun's Declination, so is Radius to the Sine of the Hour from Six of the Clock when he is East or West.

*Note 1.* The Sun is East after Six in the Morning, but West before Six in the Afternoon.

*Note 2.* The Hour found (by the last Proportion) being reduced into Time (by allowing 15 Deg. to an Hour) and added to, or subtracted from 6, gives the Hour of the Day, when the Sun is East or West.

*Example.* In 51d. 32m. North Latitude, the Sun's Declination being 23d. 29m. North, what is his Altitude, and what Time of the Day is it when he is in East or West?

*Answer,* His Altitude is 30d. 35m. and the Hour of the Day is { 7h. 21 Min. Morning, when East.  
4h. 39m. Afternoon, when West.

For (by the preceding Proportions)

1. As S. 51d. 32 m. is to S. 90d. so is S. 23d. 29m. to S. 30d. 55m. the Sun's Altitude when either East or West.

2. As T. 51d. 32m. is to T. 23d. 29m. so is S. 90d. to S. 20d. 11m. the Hour from Six; which makes 1 Hour 21 Minutes, and added to 6, is 7h. 21m. but subtracted from 6, is 4h. 39m. the former is the Time when the Sun is East in the Morning, and the latter the Time when he is West in the Afternoon.

## P R O B L E M V.

*Supposing the Sun to be in the Equator or Equinoctial (that is, to have no Declination) and the Latitude of a Place, and the Sun's Altitude to be given, to find his Azimuth, and the Hour of the Day.*

This P R O B L E M is thus performed;

1. **A**S the Tangent Complement of the Latitude is to the Tangent of the Sun's Altitude, so is Radius to the Sine Complement of his Azimuth from the South in North Latitude, but from the North in South Latitude: Easterly in the Forenoon; and Westerly in the Afternoon.

2. As the Sine Complement of the Latitude is to Radius, so is the Sine of the Sun's Altitude to the Sine Complement of the Hour from Noon.

*Example.* In 51d. 32m. North Latitude, the Sun having no Declination, and his Alt. being 21d. 50m. in the Forenoon, I demand his Azimuth and the Hour of the Day?

*Ans.* His Azimuth is South 59d. 45m. Easterly, that is, the Sun is upon the S. E. by E. a quarter E. Point of the Compass, and the Hour of the Day is Hours 8.27 Minutes Morning. For (by the above Proportions)

1. As T. 38d. 28m. is to T. 21d. 50m. so is S. 90d. to S. 30d. 15m. whose Complement is 59d. 45m. is the Sun's Azimuth required.

2. As S. 38 Deg. 28 Min. is to S. 90 Deg. so is S. 21 Deg. 50 Min. to S. 36 Deg. 50 Min. whose Complement is 53 Deg. 10 Min. or 3 Hours 33 Minutes, which sub-  
tracted

tracted from 12, gives 8 Hours 27 Minutes, or 27 Min. after 8 of the Clock in the Morning, the Time of the Day required.

# P R O B L E M VI.

*The Latitude of a Place, the Sun's Declination and his Altitude being given, to find his Azimuth, and the Hour of the Day.*

The Performance of this is as follows ;

1. TAKE the Complement of the Latitude, the Complement of the Sun's Altitude, and the Sun's Distance from the Pole (which is his Declination added to 90 Deg. when the Latitude and Declination, are one North and the other South, but both being North or South it is the Complement of the Declination, and add them together into one Sum.

2. From half that Sum subtract (to find the Sun's Azimuth) the Sun's Distance from the Pole, but (to find the Hour) subtract the Complement of his Altitude, and note the Remainder.

3. To find the Azimuth, you have these two Proportions following.

*First*, As Radius is to the Sine Complement of the Latitude, so is the Sine Complement of the Altitude to a fourth Sine. Then again,

*Secondly*, As that fourth Sine is to the Sine of the half Sum, so is the Sine of the Remainder to a fifth Sine ; against which on the Line of versed Sines is the Sun's Azimuth from the North in North Latitude, but from the South in South Latitude.

4. To find the Hour, these are the two Proportions which follow ;

*First*, As Radius is to the Sine Complement of the Latitude, so is the Sine of the Sun's Distance from the Pole to a fourth Sine.

*Secondly*,

*Secondly*, As that fourth Sine is to the Sine of the half Sum, so is the Sine of the Remainder to a fifth Sine; against which on the versed Sines, is the Hour of the Day from Noon.

*Example.* In 51 Deg. 30 Min. North Latitude, the Sun's Declination being 15 Deg. 10 Min. North, and his Altitude observed to be 11 Deg. 30 Min. I demand his Azimuth and Hour of the Day?

	d.	m.		d. m.	d. m.
	90	00		90.00	90.00
Latitude	51	30	North Declinat.	15.10	Nor. Alt. 11.30
Comp. Lat.	38	30	Sun's dist. from Pole	74.50	Com. Alt. 78.30
Comp. Alt.	78	30	Comp. Latitude	38.30	
Sun's Dist.	74	50	Comp. Altitude	78.30	
Sum is	191	50	Sum is	191.50	
half Sum is	95	55	The half Sum is	95.55	
Remainder	21	05	Remainder is	17.25	

Then to find the Azimuth say;

1. As S. 90d. is to S. 38d. 30m. so is Sine 78d. 30m. to Sine 37d. 20m. the fourth Sine.

2. As S. 37d. 20m. is to S. 95d. 55m. so is Sine 21d. 5m. to S. 36d. against which, on Versed Sines is 80d. the Sun's Azimuth from the North Easterly, if in the Forenoon, but North Westerly in the Afternoon.

And to find the Hour of the Day, it is thus;

1. As Sine 90d. is to Sine 38d. 30m. so is Sine 74d. 50m. to Sine 37d. the fourth Sine.

2. As Sine 37d. is to Sine 95d. 55m. so is Sine 17d. 25m. to Sine 29d. 40m. against which on the versed Sines, is 90d. 30m. or 6 Hours 2 Minutes, which is the Hour from Noon; that is 58 Minutes after Five of the Clock in the Morning, or two Minutes after Six in the Afternoon.

T H E



## T H E

## DESCRIPTION and USE of the

## S E C T O R.

1. **T**HIS useful Instrument may be of any Length, but it is commonly made one Foot six Inches, or two Feet long, to open with a Joint in the Middle like a Carpenter's Rule, and one Inch and a Half or more in Breadth, and of any Thickness at Pleasure, according to the Matter it is made of, which may be either Box-wood, Ivory, Brasses, or Silver.

2. There are two Sorts of Sectors, known by the Names of *Gunter's* and *Forster's* Sector, and sometimes both put on one Instrument, that is *Gunter's* Sector put on one Side of it, and *Forster's* on the other.

3. The Lines on *Gunter's* Sector are these, The *Line of Lines* (marked at the End with L) *Lines of Sines* (marked S) *Superficies* (marked Sup.) *Solids*, (marked Sol.) *Line of Metals*, *Line of Equated Bodies*, *Line of Inscribed Bodies*, &c.

4. The Lines on *Forster's* Sector are these Five, viz. The *Line of Lines*, or *Equal Parts*, *Chords*, *Sines*, *Tangents*, and *Secants*, each marked at the End with its Name, or first Letter of its Name.

5. All *Sector-Lines* or *Scales*, meet at the Center of the Head (where the Joint is) on the Left-hand, and from thence are figured towards the Right, each being twice repeated; that is, one on each Leg or Side of the *Sector*, answering one another.

The *Sector* is useful in Projection to reduce or to make a Scheme to any possible Magnitude: Also in Proportion, to work any stated Canon or Proportion in *Arithmetic*, *Geometry*, *Trigonometry*, *Navigation*, *Astronomy*, &c. of which I will give a brief Account, yet so as the Learner may be informed now to employ them further.

I. *The Use of the Sector Lines for Projection.*

**I**N Projection it is often required to enlarge or diminish the Scale, that the Draught designed may be of its desired Magnitude; in doing of which are used Lateral and Parallel Distances, or Extents of the Compasses; and to avoid a needless Repetition of the same Things, take once for all what is meant by a Lateral, and Parallel Distance, or Extent of the Compasses.

1. As *Lateral Distance* (in any Line or Scale) is the Extent or Distance taken on the same Line, on the same Side or Leg of the Sector from the Beginning thereof, to any Number therein desired.

As for Example; the Lateral Sine of 30 Degrees is the Distance of 30 from the beginning of the Line of Sines; and so it is in the Line of equal Parts, Chords, Tangents, Secants, &c.

2. A *Parallel Distance* (in any Line or Scale on the Sector) is the Extent or Distance, taken across from any Number in any Line on one Leg of the Sector to the like Number in the like Line on the other Leg of the Sector.

Or the nearest Distance from any Number on one Leg (taken across) to the like Number of the Line on the other Leg of the Sector.

As for Example: The Parallel Sine of 30 Degrees is (supposing the Sector opened to any Angle) the Distance from 30 in the Line of Sines on one Leg of the Sector, to 30 deg. in the Line of Sines on the other Leg.

Or, the nearest Distance from 30 in the Line of Sines on one Leg, to 30 in the Lines of Sines (that is to say) the Line issuing from the Center of the (Joint or Head) on the other Leg, is the Parallel Sine of 30 Degrees. In like Manner it is done in any other Line or Scale.

This being understood, the enlarging or diminishing any of the Sines, or the finding a Chord, Sine, Tangent, or Secant, to any proposed Radius, will not be difficult; and

and for the Learner's further Information take this General Rule.

I. *To find the Chord, Sine, Tangent, and Secant, &c. to any Radius (greater or less) proposed.*

The General RULE is thus ;

1. Take the proposed Radius in the Compasses, and make it a Parallel on the Sector in the Radius of any one Line, that is, open the Sector till the proposed Radius in the Compasses, be a Parallel Chord of 60 Degrees in the Line of Chords ; or a Parallel Sine of 90 Degrees in the Line of Sines ; or a Parallel Tangent of 45 Degrees in the Line of Tangents ; or a Parallel Secant of 0 Degrees in the Line of Secants ; for the Chord of 60, Sine of 90, Tangent of 45, and Secant of 0 Degrees are equal, and each equal to Radius.

2. The Sector being kept at that opened Distance, or Angle, the Parallel Distance in any Line will be a Lateral Distance on a like Line to the proposed Radius, that is, a Parallel Chord of 10, 20, 30, &c. is the Chord of 10, 20, 30, &c. to the proposed Radius ; also a Parallel Sine, Tangent and Secant of 20, 30, 40, &c. is the Sine Tangent and Secant of 20, 30, 40, &c. to the aforesaid Radius.

II. *The Use of the Sector in working Proportions.*

Supposing the Learner understands how to take a Lateral Distance on the Line of Lines (otherwise called Equal Parts) on the Chords, Sines, &c. and to apply them parallel in any Time on the Sector, the working of a Proportion is thus ;

*A General Rule to work by the Sector.*

1. Take the Second Term Lateral (that is, from the Beginning of the Line to the proposed second Term) and opening the Sector, apply that Extent Parallel (that is,

is across) in the first Term; then stay the Sector at this Parallel Extent.

2. Take the Parallel Distance of the third Term, and measure it Laterally, and it gives the fourth Term sought or required.

Or briefer thus: As the Lateral second Term is to the Parallel first Term; so is the Parallel third Term to the Lateral fourth Term.

This one Rule is sufficient for any Proportion whatever, and will appear so by a few Examples.

**P R O B. I.** *To multiply by the Line of Lines on the Sector.*

The Proportion is,

**A S** 1 is to the Multiplier, so is the Multiplicand to the Product.

*Example.* What is the Product of 8 multiplied by 4?

The Analogy, or Proportion is this ;

As 1 is to 4, so is 8 to the Product 32, thus found by the Sector, and general Rule aforesaid.

1. On the Line of Lines, (that is the Line of Equal Parts) take the second Term 4 Lateral, that is, from the Center of the Joint, and the Beginning of the Line to 4 in the same Line.

2. Open the Sector till you fit the (aforesaid Lateral) Distance in the Compasses in the Parallel of 1 and 1, or 10 and 10, that is, set it over from 10 to 10 at the End of the same Line, and now being counted for 1 and 1, the first Term keep the Sector just at that Angle or Opening.

3. The Parallel Distance of the third Term 8; that is, from 8 to 8 taken across from one Leg to the other in the said Line of Lines, and measured Laterally (that is, from the Beginning of the Line towards the End) reacheth to 32 the fourth Term, which is the Product of 8 multiplied by 4. Or shorter thus :

As

As the second Term 4 (Laterally taken) is to the first Term 11 (parallelly set) so is the third Term (taken Parallel) 8, to the fourth Term (measured Literally) which is 32, the Product as above. Or thus, As the Lateral 8, is to the Parallel 11, counted for 1, so is the Parallel 4, to the Lateral 32, as above.

## P R O B L E M II.

*To divide by the Line of Lines on the Sector.*

The Analogy, or Proportion, is thus :

**A**S the Divisor is to 1, so is the Dividend to the Quotient. Or thus ;

As the Divisor is to the Dividend, so is 1 to the Quotient.

*Example 1.* How many Square Yards are in 36 Square Feet? *Answer*, 4 Square Yards. For (by the above Proportions,)

As 9 is to 1, so is 36 to the Quotient 4 : Thus to be wrought by the Sector ; As Lateral 1 is to Parallel 9, so is Parallel 36 to Lateral 4, the Yards required.

## P R O B L E M III.

*To work the Rule of Three by the Line of Lines on the Sector ; or unto three Numbers given, to find a fourth in Geometric Proportion.*

The Analogy is,

**A**S the first Term is to the second Term, so is the third Term to the fourth required.

*Example 1.* If the Diameter of a Circle be 14 Inches, what is the Circumference? *Answer* 44 Inches, For, by the Proportion is thus ;

As 7 is to 22, so is the Diameter 14 to 44 the Circumference required ; by the Sector thus wrought, as Lateral 22, is to Parallel 7, so is Parallel 14, to Lateral 44, the Circumference of a Circle whose Diameter is 14.

*Example*

*Example 2.* If a Plank or Board be 15 Inches broad, and 20 Feet long, how many Feet are in it? *Answer*, 25 Feet; For the Proportion is this;

As 12 is to 15 the Breadth, so is 20 the Length, to 25 Feet, the Content of the Board: And by the Sector thus, as Lateral 15 is to Parallel 12, so is Parallel 20, to Lateral 25 Feet, the Content of the Plank.

#### P R O B. IV. *The Use of the Sector in Plane-Sailing.*

*Example 1.* A Ship in 42d. 10m. North Latitude sails NE. by N. 104 Leagues; I demand the Latitude she is in, and her Departure from the Meridian?

The Proportions are these;

1. As Radius is to the Distance sailed, so is the Sine of the Course to the Departure from the Meridian. That is by the Sector, thus; As Lateral 104 Leagues (on the Line of Lines) is to Parallel Sine of 90 Degrees, so is Parallel Sine of 33 Degrees 45 Minutes (the Degrees of the Course from the Meridian) to Lateral 58 Leagues (on the Line of Lines) the Departure from the Meridian.

*Note*, If 104 Leagues taken Lateral, be troublesome to fit Parallel in the Sine of 90 Degrees, then take its half, or quarter laterally, and its Answer will be accordingly its half or quarter: As here, if you take 52 the half of 104 Leagues, the Answer will be 29, whose Double is 58 for the Departure from the Meridian, as before.

2. As Radius is to the Distance sailed, so is Sine Complement of the Course to the Difference of Latitude.

*By the Sector thus;*

As Lateral 104 Leagues is to the Parallel Sine of 90 Deg. so is Parallel Sine of 56 Deg. 15 Min. to the Lateral 87 Leagues, the Difference of Latitude; by which you may find the Latitude the Ship is in, as before, in the Use of the Gunter, in Pages 209 and 210.

*Example*

Example 2. A Ship sails South Easterly 'till her Difference of Latitude be 275 Minutes, and the Departure from the Meridian 412 Minutes, I demand her Course and Distance sailed?

The Proportions are these;

1. As the Difference of Latitude, is to the Departure; so is Radius, to the Tangent of the Course: That is,

By the Sector thus:

As Lateral 412 Minutes, is to Parallel 275 Minutes; so is Parallel Tangent of 45d. (that being Radius now) to Lateral Tangent of 56d. 15m. the Course from the Meridian, which makes SE. by E.

2. As the Sine of the Course, is to the Departure; so is Radius, to the Distance sailed.

By the Sector thus:

As Lateral 412 min. is to Parallel Sine 56 deg. 15 min. so is Parallel Sine of 90 deg. (that now being Radius) to Lateral 495 min. the Distance sailed.

After this Manner may any Proportion be wrought by the Sector, which I leave for the Learner's Excise.

## The Use of the following TABLES of Latitudes and Longitudes.

**L**atitude and Longitude are two primary Affections of the Earth: By the Help of these two, the Geographer endeavours to represent the Parts of the Earth, that they may keep symmetry and Proportion with the Whole.

Latitude is an Arch of the Meridian, comprehended between the Equator and a Parallel: But Longitude is an Arch of the Equator, intercepted between the Meridian of London, in the following Tables, and the Meridian of any other Place.

For the exact settling of Latitude, we have many absolute Helps; but to determine the Longitude of a Meridian,

Q

and

and more especially the Longitude of a Place at Sea, is that which hath, and still wearies the greatest Masters of Geography.

I have endeavoured to settle the Longitude with as much Exactness as possibly I could: For I not only calculated according to the Latitude and Meridian Distance of each Place from the Meridian of London, which Meridian Distance I obtained from the exactest geographical Charts extant, but I consulted the Reckonings of skilful Mariners, and when I found any Difference, I adjusted it both according to Art and Reason.

As for Instance; I had from able Mariners, upon their long Experience, the Meridian Distance from Barbadoes to the Lizard: According to which I have settled the Longitude of all the eminent Places in the West Indies.

And for the settling of the Longitudes of Places in the East-Indies, I consulted Observations of Eclipses, both ancient and modern; as in Page 161 Harmonicon Cœleste, the Difference of Meridians between Goa and London is 5h. 48m. and Malacca and London, 6h. 49m. My Table hath the former of these 5d. 58m. and the latter 6h. 45m. The Difference between my Tables and the former of these Observations is 10m. and of the latter 4m. which Difference may be bore withal.

“ If the Reader considers the Time, being in 1664, with the great Labour and Pains (to my Knowledge, being then his Servant) the Author bestowed and expended in compiling this Work, the Performance may justly be looked upon as then the best of its Kind.

“ But since that Time there have been better Helps, new Discoveries made, and new Places found out; the Corrector, at the Request of the Booksellers, and out of Respect to the deceased Author, but most of all for the publick Good, hath made such Amendments herein as were possible, by comparing of the best Observations, Tables, Charts, Maps, and Sea Journals he was able to procure; so that it may be concluded these Tables are  
“ the



“ the trueſt, or come in general, neareſt the Truth of any  
“ extant in our Language; not that they are ſo exact in  
“ every particular Place, as to need no Amendment in  
“ Time, but with Reſpect to the preſent Help they are ſo.

“ And now I could wiſh, that either Authority would  
“ order, or that all Perſons concerned in conſtructing  
“ Tables, Charts, and Maps, would mutually unite in a  
“ fixed Meridian where to begin Longitude.

“ For, although Longitude may be begun at any Meri-  
“ dian, yet the Convenience of it beginning at one Meri-  
“ dian in all our Navigation Books and Charts, would  
“ render the Study and Practice of Navigation much  
“ more pleaſant and eaſy than now it is: Such various  
“ Beginnings and Countings of Longitudes occaſion ſome  
“ to ſtumble, others to miſtake, and ſome to condemn all  
“ to be falſe, by not conſidering the ſeveral Meridians  
“ made Uſe of, which ſuch a wiſhed-for Union would  
“ prevent.

“ But this is not likely to be in my Time, who am  
“ ſo near the Grave; yet ſhould it be ſet on Foot while  
“ I am on this ſide the other World, my beſt Perform-  
“ ances ſhould not be wanting to promote it, and ſhould  
“ count all my ſpare Hours from neceſſary Preparations  
“ for my laſt End, well ſpent in ſuch an uſeful and public  
“ Good.”

Note 1. I do begin the Longitude (in my Tables) at  
the Meridian of London, and increaſing it on both Sides  
the ſaid Meridian; that is to ſay, both Eaſtward and Weſt-  
ward, and end in 180 Degrees the oppoſite Meridian.

2. Therefore (according to this Account) all Places  
on the Eaſt Side of the Meridian of London lie in Eaſt  
Longitude; and, on the contrary, all on the Weſt Side  
of it lie in Weſt Longitude.

3. If a Ship be in Eaſt Longitude, ſailing to the Eaſt-  
ward, the Longitude increaſeth; but ſailing to the Weſt-  
ward the Longitude decreaſeth.

4. And on the contrary, if a Ship be in West Longitude sailing to the Westward, the Longitude increaseth, and sailing to the Eastward, it decreaseth.

5. Take Notice, that all Places in East Longitude, the Sun cometh on their Meridian before he cometh on the Meridian of London. As thus; if a Place lie in 15 deg. East Longitude, the Sun cometh one Hour sooner to the Meridian there, than he doth to the Meridian of London: If in 30 deg. East Longitude, than two Hours sooner; if 45 deg. three Hours sooner; if 60 Degrees four Hours sooner; if 75 deg. five Hours sooner; if 90 deg. six Hours sooner; if 105 deg. seven Hours sooner; and so you may reckon for any other Longitude. But on the contrary, all those Places that lie in West Longitude, the Sun or Star cometh on their Meridian after they are past the Meridian of London.

To find the Difference of Longitude between any two Places.

**I**F both Places be in East Longitude, or both in West Longitude, subtract the less Longitude from the greater, the Remainder is the Difference of Longitude.

If one Place be in East Longitude, and the other in West Longitude, add them both together, and their Sum is the Difference of Longitude, if it exceed not 180 deg. but when the Sum doth exceed 180 deg. subtract it from 360 deg. and the Remainder is the Difference of Longitude required.

Note, That the Longitudes of Places, tabulated in Mr. COLSON's Mariner's New Calendar, heretofore estimated from the Meridian of the Lizard, are in the last Edition of that Book, reduced to the Meridian of London.

*A TABLE containing the Chief Harbours, Headlands and Islands in the World, and shewing their Latitude and Longitude: Begining the said Longitude at the Meridian of London.*

**The Sea-Coast of Greenland.**

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
<b>H</b> Acluits Headland —————	79	47	09	11
Fair Foreland —————	78	45	08	56
Cape Cold, the North-end of } Charles Island ————— }	78	50	09	30
Black Point, South-end of it —————	78	13	10	33
Dear Sound —————	79	15	12	40
Foul Sound —————	77	20	13	00
Bell Sound —————	77	15	12	40
Horn Sound —————	76	50	13	26
Point Lookout —————	76	25	15	34
Helies Sound —————	78	55	21	50
Cape Barcan, or Barcam —————	78	15	22	11
Cape Blanco —————	77	55	20	10
Ducks Clove } Edges Island ——— {	77	35	23	10
Negro Point }	76	55	23	30
Hope Island —————	76	18	23	40
Cherry Island, or Bear Island —————	74	30	18	20
Ice Point, or Cape Desire —————	77	40	69	10
Admiralty Island —————	75	05	54	50
Langeness —————	74	40	53	36
Cross Point —————	72	00	53	12
Fretum Burrough —————	70	00	61	20
Colgoyen Isle —————	69	00	45	00
Cape Candemose —————	69	03	42	35
Cape Barso —————	66	30	38	00

North Latitude

East Longitude

The Coasts from Archangel to the Naze of Norway.

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
Archangel	64	34	38	00
Cape Grace, or Cape Bona Fortuna	66	00	35	50
Cape Gallant, or Sweetnose	68	10	34	40
Kilduyn Island	69	30	31	20
River Kola Entrance	69	10	31	05
Fishers Island	70	00	26	38
North Cape	71	23	23	02
Tromsund Island	70	20	19	00
Island Sanien, South West Point	69	35	13	00
Læford, West Point	68	15	09	40
Werro, or Weroy Island	67	30	07	30
Dronthem	63	20	10	59
Randsel	63	15	06	30
North Point	62	20	05	26
Katts Nefs, or Scuts Nefs South Point	61	45	03	36
Hearle Island the South-end	60	40	03	38
North Bergen	60	10	06	14
Bommel Island, North Point	59	25	05	40
Jedder	58	05	06	10
Naze of Norway	57	45	07	24
Masterland	57	53	11	45

North Latitude

East Longitude

Sea

The Sea-Coasts in the Sound.

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
Maerden	58	19	08	57
Caperwick	59	20	10	10
Anſlew, or Chriſtiana	59	40	10	00
Gottenberg	57	50	12	10
Cape Kol	56	30	12	23
Elfenberg	56	10	12	30
Vallſtenborn	55	28	13	00
Chriſtianople	56	00	15	12
Calmer	56	40	16	35
Oeland the { South-end	56	17	15	30
{ North-end	57	20	17	00
Landford	58	40	18	20
Stockholm	59	20	18	30
Aboo	60	40	21	10
Raſeborg	60	28	22	35
Borgo	60	40	26	00
Pelting Sound	60	32	26	50
Wyburg	60	52	29	16
Petersburg	60	00	30	25
Narva	59	07	29	15
Revel	59	27	24	51
Nargin Iſland	59	35	24	30
Sybranneſs in Dagoo, or Dagerort	59	00	23	00
Arenſberg in Geſel Iſland	58	20	23	32
Parnaw	58	30	25	47
Runen Iſland	57	55	24	00
Riga	57	00	24	55
Domenesſs	57	30	24	00

East Longitude

North Latitude

## The Sea-Coasts in the Sound.

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
Der Winda	57	15	22	06
Der Memel	55	48	21	36
Coningsburgh	54	43	21	35
Dantzic	54	22	18	36
Heel	54	40	19	08
Gotland, the North-end	58	00	20	15
Faro Sound	58	03	18	50
Gotland Wisbuy	57	30	18	30
Gotland, the South-end	57	00	17	45
Bornholm	55	12	15	40
Camin, or Hamin	54	10	15	00
Jasmond, or Rugen	54	40	14	00
Rostock	54	37	18	40
Strelfound	54	25	13	16
Wismar	54	10	12	00
Lubec	54	00	11	45
Copenhagen	55	41	12	50
Ellinore	56	22	12	40
Uraniberg	55	54	12	58
Anout, or Anholt Island	56	50	11	06
Lefon, or Lefnow Island, Jesou	57	05	10	30
The Scaw	57	30	10	20

North Latitude

West Longitude

## The Sea-Coasts of Holland and Flanders, from the Scaw to Calais.

Holy Land, or Heighland Isle	54	24	08	35
Hamburgh	53	41	10	38
Bremen	53	30	09	00
Embsen	53	05	07	28
Ameland Island, or Amoyland	53	30	06	20
Schelling	53	27	05	58
The Fly	53	16	05	30

North Latitude

East Longitude

The Sea-Coasts of Holland and Flanders, from the Scaw to Calais.

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
The Texel	53	12	05	10
Amsterdam	52	23	05	14
Rotterdam	51	55	04	35
Antwerp	51	10	04	20
The Brill	52	00	04	00
Middleburgh in Zealand	51	37	03	58
Sluys	51	14	03	43
Ostend	51	14	03	00
Dunkirk	51	04	02	27

North Latitude  
East Longitude

The Sea-Coasts about the Island of Iceland.

Grim's Hole, or Geuberman's Rocks	}	66	23	22	30
Gamar Isles, or Gille		65	48	26	54
Westmania Isles		63	30	22	54
Rock Point		64	00	26	24
Snow Hill		65	11	27	14
Fair Foreland		60	20	26	23
Rage Point, or Orgal Bay		66	00	25	25
Marza, or Largenefs		66	08	24	00
Grimfa Ifle		67	15	22	34
Langenefs		66	46	12	50
Bargarers Point		66	20	16	35
Silly, or Pappy Isles		64	50	12	10
Horn Bay		64	50	12	00
Merchants Foreland		63	24	17	05
Portland		64	02	21	05
Green's Island		66	50	24	40

North Latitude  
West Longitude

## The Sea-Coasts of Scotland.

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
Sky Island North-end	57	45	05	45
Island of Lewis, North-end	58	20	07	00
Ferro Head, or S. End	61	15	05	10
Shetland South-end	60	04	02	00
Fair Isle	59	30	01	24
Isles of Orkney	59	10	03	22
Cath Ness Point	58	40	02	36
Buchan Ness	57	45	01	18
Aberdeen	57	02	01	44
Dundee	56	28	02	40
Leith	56	00	02	56
Edinburgh	55	58	02	59
Berwick	55	45	01	55

North Latitude

West Longitude

## The Sea-Coasts of England from Berwick to the Lizard.

Newcastle	55	12	01	30
Sheiles, or Shields	55	02	01	23
Sunderland	54	55	01	20
Hartlepool	54	43	00	56
Whitby	54	10	01	50
Scarborough	54	20	00	40
Flamborough Head	54	09	00	19
Burlington	54	00	00	08
The Spurn	53	35	00	30
Hull	53	52	00	20
Grimesby	53	30	00	56
Boston	53	10	00	25
Gynn	52	55	00	32
Wells	53	10	01	00
Blackney	53	08	00	55
Cromer	53	10	01	05
Winterton	52	57	01	22
Yarmouth	52	52	01	38

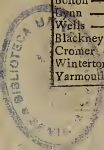
North Latitude

W. Longitude

E. Lon.

W

East Longitude





The Sea-Coasts of England from Berwick to the Lizard.

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
Aldborough	52	20	01	25
Orfordness	52	12	01	16
Ipswich	52	10	01	05
Harwich	52	05	01	18
Colchester	51	58	00	56
L O N D O N	51	31	00	00
Rochester	51	28	00	26
Margate	51	27	01	14
The North Foreland	51	27	01	24
Sandwich	51	25	01	14
The Downs	51	23	01	25
The South Foreland	51	10	01	20
Ripraps, a Sand	51	53	01	26
Dover	51	06	01	13
Dungeness	50	57	00	51
Rye	51	02	01	45
Beachy	50	46	00	25
Shoreham	50	55	00	17
Portsmouth	50	49	00	50
Isle of Wight, Newport	50	42	01	25
Pool	50	56	01	54
Weymouth	50	42	02	40
Portland	50	30	02	44
Chiddock	50	46	02	52
Lime	50	43	02	58
Exmouth Bar	50	38	03	25
Berry Head, the S. Point of Torbay	50	26	03	30
Hopes Nose, the N. Point of Torbay	50	30	03	30
Dartmouth Entrance	50	22	03	35
Start Point	50	06	03	45
Praule Point	50	15	03	45

East Longitude

North Latitude

West Longitude

## The Sea-Coasts of England.

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
The Eddystone	50	14	04	20
Plymouth	50	25	04	09
Ramhead	50	21	04	34
Foy	50	23	04	38
Falmouth	50	11	05	01
L I Z A R D	50	00	05	14

North Latitude

West Longitude

## The Sea-Coasts from the Lizard to Holy-Head.

Land's End	50	06	06	00
Gulf	49	56	06	06
Scilly Islands, St. Agnes Lighthouse	49	56	06	34
Seven Stones	50	10	06	40
Hartland Point	51	03	04	31
Lundy Isle	51	13	04	38
Mort Bay, or Mort Point	51	13	04	13
Bristol	51	30	02	30
Swansey	51	42	03	55
Caldy Island	51	37	04	38
Milford	51	43	05	00
St. David's Head	51	56	05	11
Barfey, or Bardsey Island	52	50	04	35
Liverpool	53	20	03	00
Winchester	53	37	04	20
Lancaster	54	42	04	36
White Haven	54	17	03	30
Isle of Man, West-end	53	45	05	00
Holy-Head	53	23	04	40

North Latitude

West Longitude

The Sea-Coasts of Ireland.

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
Fair Foreland	55	05	06	30
London Derry	55	00	07	50
Island Torre	55	09	08	30
Isles of Arran	54	48	08	59
Stags of Broad Haven	54	07	10	06
Isles of Arian	54	55	10	03
Galway	53	07	09	40
Gall, or Doen's Head	52	40	09	30
Lupis's Head	52	24	10	15
Limrick	52	23	09	45
Blasques	52	00	11	56
Skillocks	51	30	11	55
Cow and Calf	51	22	10	30
Mizan, or Miffen Head	51	16	11	30
Old Head of Kinfale	51	35	08	58
Cape Clear	51	17	11	10
Kinfale	51	50	09	40
Cork	51	45	07	30
Waterford	52	09	08	40
Wexford	52	13	07	27
Dublin	53	12	06	55
Lumboy Island	53	24	07	30

North Latitude.

West Longitude.

The Sea-Coasts of France.

Calais	50	58	01	56
Dieppe	49	56	01	09
St. Vallery	50	10	00	56
Sain Head, Cape de Antifer	49	44	00	34
Rouen Mouth	49	34	00	30
Cape Barfleur	49	38	01	16W
Cape de la Hogue	49	47	02	00W

North Latitude

E. Long.

## The Sea-Coasts of France.

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
Alderney	49	50	02	12
Caskets	49	50	02	20
Guernsey	49	33	02	40
Jersey	49	05	02	26
St. Maloes	48	39	01	57
Morlaix	48	33	03	49
Island de Bass	48	50	04	00
Ushant	48	30	05	02
Conquet	48	27	05	00
Brest	48	23	04	26
Camarita Bay	48	25	04	28
Seams	48	02	05	00
West Penmark	47	48	04	24
Bell Isle	47	21	03	16
Nantz	47	14	01	39
Heys Isle	46	24	02	14
Isle de Rey the Middle	46	10	01	30
Isles of Oleron	45	56	01	00
Rochel	46	10	01	11
Bourdeau City	44	50	00	30
St. Sebastian	43	24	01	27
Bilboa	43	29	02	58
Cape Pinas	43	56	06	00
Cape Ortegal	43	47	08	32
Cape Corunna, or Groin	43	28	09	20
Cape Finisterre	43	15	09	40
Isles of Bojona	42	29	09	27
Oporto	40	50	09	35
Burlings	39	35	09	48
Rock of Lisbon	38	42	09	50
Lisbon	38	42	08	53
Cape St. Vincent	36	53	09	06
Cape St. Maria	36	58	08	30
Cadiz	36	33	06	00

North Latitude

West Longitude

The Coasts on the Main Continent within the Straits.

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
Gibraltar	36	12	04	53 W
Malaga	36	48	03	50 W
Cape de Gat	36	30	02	05 W
Cape Paul	38	15	00	15 W
Alicant	38	35	00	05 W
Cape St. Martin	38	46	00	40
Barcelona	41	26	02	18
Marseilles	43	18	05	27
Toulon	43	07	06	02
Genoa	44	25	08	43
Leghorn	43	38	10	25
Civita Vecchia	42	10	12	25
Rome	41	54	12	45
Naples	40	51	14	46
Cape Spartevento	37	50	16	45
Cape Colonne	38	56	18	05
Gallipoli	39	56	18	43
Cape St. Maria, or Lucia	39	45	18	30
Ancona	43	40	14	26
Venetia, or Venice	45	25	12	10
Zara	44	30	16	35
Ragusa	42	45	20	00
Cattaro	42	47	19	17
La Valona	40	45	20	05
Point Palermo	40	00	20	15
Lepanto	38	20	22	02
Cape Matapan, or Caliga	36	33	22	41
Cape St. Angelo, or Angulo	36	32	23	56
Athens	37	58	24	05

North Latitude

East Longitude

## The Coasts on the Main Continent within the Straits.

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
Cape Martelo, South Point of Negropont ————— }	38	07	25	03
Cape Colon, or Collonne —————	37	45	24	42
Salonechi —————	40	41	23	13
Cape Monte Sancto —————	40	26	25	02
Gallipoli —————	40	33	27	20
Constantinople —————	40	59	28	58
Cape Barbador, or Baba —————	39	30	26	30
Smyrna —————	38	28	27	25
Cape Barbernola, or Blane —————	38	09	26	32
Ephefus —————	38	00	27	53
Antiochetta —————	36	30	32	46
Scanderoon, or Alexandretra —————	36	34	36	30
Antioch —————	36	11	36	15
Aleppo —————	35	45	37	24
Tortosa —————	35	00	36	30
Tripoly —————	34	38	36	15
Joppa, or Jaffa —————	32	27	35	20
Jerusalem —————	31	51	35	25
Alexandria —————	31	10	30	19
Cape Rufato —————	32	48	21	25
Cape Mesurato —————	32	21	16	17
Tripoly —————	32	54	13	10
Sufa —————	35	53	10	34
Cape Bona —————	37	13	10	04
Tunis —————	36	50	10	17
Bona —————	37	08	07	10
Seven Capes —————	37	15	07	00
Gigeri —————	37	14	06	15
Cape Tidelles, or Dellys —————	37	15	04	18
Algier —————	36	50	03	16
Cape Tenes —————	36	45	01	50
Orain —————	36	02	00	26
Cape Tres Forcas —————	35	30	02	04 W
Ceuta —————	35	54	04	45 W
Tangier —————	35	52	05	42 W

Islands within the Straits.

Names of Places.	Latitude		Longit.	
	D.	M.	D.	M.
Formentura	38	33	01	55
Ivica	38	50	01	40
Majorca	39	46	02	03
Minorca	39	51	03	52
C. Tolare, South } End of Sardinia {	38	46	09	12
C. Corfo, North }	41	10	09	50
Afinaria	41	03	09	08
Bonifacio, South } End of Corsica {	41	24	09	46
C. Corfo, North }	42	56	09	50
Capri, or Capria	43	03	10	17
Lilboa, or Elba	42	45	11	00
Planosa	42	30	10	45
M. Christo	42	17	11	00
Palmarolla, or Palmeria	41	03	13	35
Ponfa	41	00	13	37
Ischia, or Eschia	40	54	14	30
Strombello	38	58	16	00
Velcanello	38	27	15	33
Fellicur	38	30	15	00
Allicur	38	28	14	42
Ustica	38	36	13	52
Trapano West End of	37	57	13	13
Palermo in	38	06	13	50
C. Passaro East End of } Sicilly	36	38	15	40
Messina in	38	07	16	20
Quiracusa in	37	03	15	45
C. Molin in	37	42	15	56
Pantalasia	36	48	12	20
Limosa	35	56	13	11
Lampidosa	35	34	12	46
I. Malta	35	53	14	34
Ouvre Poel, a Rock	35	45	16	36
Grande, or I. Longo	44	25	16	18

North Latitude

East Longitude

North Latitude

East Longitude

## Islands within the Straits

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
Poma	43	10	16	08
St. Andrea	43	12	16	26
Lissa	42	46	18	40
St. Agusta	42	40	18	56
Corzola	43	03	17	32
Melada	42	52	18	06
Corfu	39	50	19	46
Chephalonia	38	15	21	00
Zant	37	46	21	30
Sapienza	36	40	21	45

East Longitude

North Latitude

## Islands in the Archipelago.

Ratio	40	40	25	17
Lemnos	39	59	25	37
Metyline { Cape Sygre	39	15	26	05
{ P. Olivia	38	57	27	00
Siatto, or Schate	39	22	23	58
Scio, or Xio	38	22	26	12
Patmos	37	20	26	45
Fino	37	35	25	36
Zio, or Sea	37	37	24	50
Perminia, Fermina, or Termine	37	24	24	58
Perfante, or Sifanto	36	58	25	20
Millo, Mila, or Melo	36	40	25	00
W. } end of Caudia { Cape St. John	35	15	24	00
E. }                    { C. Solomon	35	00	27	08
Rhodes { North-end	36	27	28	38
{ South-end of C. Tranquill	36	01	28	28
S.W. }                    { C. Baffa	34	57	32	23
East } end of Cyprus { C. St. Andrea	35	31	35	00
S.     {                    { C. de Gaffe	34	30	33	10

East Longitude

North Latitude



The Sea-Coast of Barbary and Guiney, from Tangier to  
Cape Bona Esperance,

Names of Places.	Latitude		Longit.	
	D.	M.	D.	M.
Cape Spartel	35	46	05	49
Salle	33	58	06	20
Cape Cantin	32	46	09	10
Cape de Geer	30	27	10	06
Cape de Non	28	15	11	04
Cape Bajadore	26	04	15	35
Cape Blanco	20	45	17	25
Cape de Verde	14	43	17	20
River Gambia's Entrance	13	08	15	31
Cape Roxo	11	50	15	04
Cape de Monte, or Mount	06	23	12	00
River Sester, or Sestos	05	24	08	36
Cape de Palmas	05	23	06	00
River St. Andrea	05	05	04	15
Cape Three Points	04	28	01	50
Cape Corse	05	15	00	23
River de Volta, or Accara	05	55	03	25
Cape Formosa	04	15	06	40
New Calabar Entrance	04	42	08	33
Old Calabar Entrance	04	10	09	45
River de Camarones	03	25	10	10
Island Fernand Poo	02	40	10	30
Island de Prince, or Prince's	01	40	09	15
River de Anger, or Angra	00	50	10	01
Island St. Thomas	00	00	08	00
Island St. Matthews	01	30	06	01 W
Island Ascension	07	50	14	01 W
Island Anabona	02	10	07	27 E
Cape Lopas	00	55	09	55 E
Cape Negro	16	08	12	31 E
Island St. Helena Nova	16	00	06	04 E
Island St. Helena	16	06	05	50 W
River Congou	05	40	15	25 E
Cape St. Thomas	24	50	14	43 E

The Sea-Coast of Barbary and Guiney, from Tangier to  
Cape Bona Esperance.

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
Cape Secos, Sego, or Seca —————	29	00	15	56E
Cape Bona Esperance —————	34	07	18	40E
Cape Aguilhas, or Lagullas —————	34	54	21	20E
Island Tristian de Acunha —————	37	05	13	50W

## The Sea-Coast of Brazil.

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
Island St. Paul —————	01	20	25	30
Para River —————	02	50	42	47
Cape St. Roque —————	05	00	35	47
Rio Grande —————	05	20	35	57
Pernambuco —————	08	30	35	07
Cape St. Augustin —————	08	48	35	10
Island Ferdinande Lorenha —————	03	50	31	10
River St. Francisco —————	10	56	36	40
Bay de Todos Sanctos —————	13	06	38	50
Port Segura —————	16	56	40	00
Cape de Abrolhos —————	18	15	41	07
Spirito Sancto —————	20	25	40	00
Cape St. Thomas —————	22	10	42	15
Cape Frio —————	23	00	42	20
Island St. Catherine's —————	27	50	48	00
River Grande's Entrance —————	31	55	52	00
Cape St. Waria —————	34	30	56	40
River de la Plata, or Cape St. Antonio —————	35	40	67	36
Cape de St. Andreas —————	38	40	63	05
Bay Sinfunda, or Sinfendo —————	42	35	68	00
Point de los Leones —————	44	00	70	40
River Camerones —————	45	30	73	00
Cape Blanco —————	46	50	72	07
Pepy's Isle —————	47	20	66	40
Point of River St. Julian —————	48	40	74	34
Cape Virgin Mary of Magel, Straits —————	52	00	75	05
Le Maire Strait —————	54	34	73	01

The Sea-Coasts of Brazil.

Names of Places.	Latitude.		Longitude	
	D.	M.	D.	M.
C. Horn, the S. Part of Terra del } Fuego _____	55	22	67	02
Island dos Picos _____	22	30	25	15
Island de Martinvas _____	19	30	26	55
Island St. Maria de Agosta _____	19	40	29	10
Island Trinidade _____	20	30	30	00
Island Ascension _____	08	0	14	30

The Coasts on the Main Continent in the East-Indies.

Bay de Allogoor Dallagoa _____	25	30	31	05
River St. Lucia _____	28	20	32	17
Cape St. Martin, or Maria _____	22	40	35	05
Cape Corientes _____	23	40	36	17
Mofambique _____	15	02	41	40
P. de Aquada, or Del Gada _____	10	17	40	10
Cape de Falfo _____	09	00	39	20
Tongon _____	04	50	38	59
Mombaso _____	03	50	38	30
Molinde, or Melinde _____	02	58	39	35
River Lamos _____	01	20	40	13
Magadoxa _____	02	50	45	20
Cape de Bassas, or Boxos _____	04	06	47	38
Cape de Gardefoy _____	11	14	51	20
Aden _____	13	00	47	00
Mocha _____	14	10	44	50
Cape Matriaca _____	15	23	52	10
Defar _____	17	00	55	35
Cape Refulgat _____	22	41	59	45
Muscat _____	23	12	57	45
Bassora, or Bufero _____	29	45	49	20
Gambaroon _____	27	20	56	40
Cape Glado _____	25	50	63	34

## The Sea-Coasts on the Main Continent in the East-Indies

Names of Places.	Latitude		Longit.	
	D.	M.	D.	M.
River de Sinda, or Cinde	24	45	67	35
Dia Head	21	02	69	50
Surat	21	10	72	25
Demam	20	06	73	30
Bombay Island	19	18	73	06
St. John's	19	55	73	20
Chaule, or Choale	18	31	73	37
Dabul	18	23	74	30
Rajapour Isle	17	02	74	10
Goa	15	31	73	50
Carwar	14	47	75	00
Manqu Shore	12	53	75	25
Tellecherry	11	42	75	25
Calecut	11	16	75	39
Cannanon	10	22	75	35
Cochin	09	54	75	55
Anjanga	08	29	76	25
Cape Comarin	07	50	77	25
Columbo in Zeylone	07	07	79	30
Point de Galie, or Gallo, on the same	06	10	80	10
Dundre Head on the same	06	02	80	45
Trincomale	08	40	81	40
Great Bassos Shoals	06	23	81	45
Jetrapatam	09	05	80	10
Negrapatam	11	01	79	55
Tincumbar	11	15	79	50
Porto Nova	11	45	79	44
Pondicherry	11	54	80	06
Fort St. David, or Tregapatam	12	05	80	55
Conymere	12	35	80	05
Fort St. George, or Madraffapatam	13	11	80	12
Palliakate	13	40	80	50
Armegon	14	16	80	12
Petapoli	16	16	81	11
Due Point, or Mecha	16	08	81	32
Mafulipatam	16	28	81	40

North Latitude

East Longitude

The sea-Coasts on the Main Continent in the East-Indies

Names of Places.	Latitude		Longit.	
	D.	M.	D.	M.
Maffipore	16	30	81	57
Vifagapatam	17	43	83	57
Birmalapatam	17	51	84	09
Pondy	18	49	85	15
Jacarnaut Pagod	19	51	86	42
Atsepure	29	11	87	23
C. Palmiras	20	40	87	35
Balafore Road	21	16	87	48
Piply	21	25	87	57
Hughly	23	09	89	05
Dacca	23	57	90	55
Casimbazar	25	06	88	45
River Bengal	22	17	92	21
River Aracan	20	10	93	40
Pegu	17	05	96	56
Melacca	02	12	102	10
Formosa N. Point	21	25	121	26
Point Romania	01	16	103	15
Point Cui	12	10	99	02
Siam Entrance	14	18	100	55
Cambodia Entrance	10	28	105	00
Cape Anarilla, or Avarilla	13	25	108	03
Cochin, or Chinchin	14	05	107	56
Tonquin	20	50	105	40
Canton	23	08	113	08
Amoye Island	24	35	116	50
Hockfew	26	30	118	20
River Swadia	27	51	118	50
Liampo, Lingpo, or Ningpo	29	59	120	35
Island Chufan	32	06	118	35
Nankin	32	07	118	31
Pekin	39	54	116	28

Islands in the East Indies.

St. Paul	38	20	75	25
Romerans de Castelamas	28	45	67	17
St. Joan de Lisbon	25	24	53	30
Diego Roys	19	50	61	20

## Islands in the East-Indies.

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
St. Brandon	16	38	64	30
Mauritius	20	10	57	35
Málha	11	15	60	30
C. St. Mary S. } End of St.	25	33	46	10
C. D' Ambre N. } Laurence	12	10	51	05
St. John de Nova	17	21	43	20
St. Christova	17	36	43	40
Mayetta	13	04	36	18
Joanna	12	10	45	03
Mohilla	12	05	44	23
Comero, or Angazecha	11	40	43	50
Morfia, or Monfia	08	07	40	15
Zanzebar	06	48	39	57
Penda	05	20	39	35
Comero	10	30	44	39
Cosmoledo	10	24	51	17
Juan de Nova	09	30	52	40
Astore Isle	09	55	53	50
Agalega, or Gallega	09	47	54	31
Setta Hernanes	02	47	59	13
Quevelo, or Quebello	03	53	52	36
Bassas de Banhas	05	05	48	46
Hermanos	03	32	54	45
Island Gratio	06	10	63	01
Padra Banhas	02	10	65	32
Bassas de Chagos, or the Island } Chagos	06	55	68	45
Three Germans	04	30	62	43
Cross Island	04	10	58	05
Sacatora, or Zacatora	12	21 N	54	05
Island Abdeleur	12	04 N	53	04
Cubello	08	10 N	71	45
Malique	09	00 N	72	58
Garipe, or Gripe	10	40 N	72	37

South Latitude

East Longitude

Islands in the East-Indies.

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
Qualpena	10	00	73	30
Andomahon, or Antada	11	10	73	32
Ceylone South End, C. Gallo	06	08	81	15
Waldivia { South } Part	00	25	76	22
{ North }	07	14	73	04
Yas de Diego Reys	00	20	72	00
Mamila	14	25	117	06
Aynian— { N.W. } Point	19	30	107	00
{ N.E. }	19	55	109	55
Japan — { S.E. } Point	35	30	140	30
{ S.W. }	35	00	128	30
Kocas	04	10	91	02
Andaman the Middle	12	35	93	19
Borneo W. Point	03	50	108	58
Nicobar	07	11	93	40
North-West End of Sumatra	05	22	94	50
Bencola	03	55S	104	00
South-East End of Sumatra	05	22S	105	50
Jambe	01	19S	102	55
B. ntam	06	14S	106	25
Batavia	06	16S	106	16

North Latitude

East Longitude

The Southern Islands, or Cape de Verde Islands.

St. Antonio	17	35	24	26
St. Vincent	17	15	24	25
St. Lucia, or Round Island	17	07	24	20
St. Nicholas	17	00	23	38
Ile de Sal	16	55	21	56
Bonavista	16	05	22	08
Mayo, or Island May	15	14	22	08
St. Jago	15	08	22	45
Fuego, or Fulgo	14	50	23	45
Brava's	14	28	23	44

North Latitude

West Longitude

## The Canary Islands.

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
Sancto Porto	32	58	16	20
Madeira West-end	32	23	17	13
Salvages	30	14	15	00
Palma	28	40	17	50
Ferro	27	54	17	45
Gomero	28	06	17	05
Pico Teneriff	28	13	16	28
Grand Canaria	27	52	15	10
Allegansa	29	40	12	13
Lancerota	29	30	12	25
Porteventura South-West End	28	05	13	30

North Latitude.

West Longitude.

## The Western Islands.

Corvo	39	48	31	25
Flores	39	32	30	54
Fyal	38	33	28	05
Pico	38	40	27	50
St. George	38	50	26	03
Tercera	38	57	27	04
Gratiosa in Eura	39	06	26	11
Wha e Fith	39	37	25	11
Vajo, or Vegia	38	43	23	48
St. Michael	38	06	23	36
Formiga, or Hormigas	37	40	22	47
St. Maries	36	59	22	58

North Latitude.

West Longitude.

## The Sea-Coast of the North Part of America, Hudson's Bay, and Newfoundland.

Cape Farewell	59	45	44	45
Cape Elizabeth	62	03	66	50
Island Resolution	61	50	65	04
Queen Anne's Foreland	63	48	54	45
Salvages Island	62	40	70	17
Salisbury Island	63	45	77	15
Mill's Isle	64	26	80	18
Nottingham Isle	63	30	76	53

North Latitude.

West Longitude.



The Sea-Coasts of the North Part of America, Hudson's Bay, and Newfoundland.

Names of Places.	Latitude		Longitude	
	D:	M.	D.	M.
Shark Point	64	30	82	55
Cape Southampton	61	55	86	18
Sir Thomas Roe's Welcome	64	15	92	04
Cape Churchill	59	00	95	16
Port Nelson, or York Fort	57	10	93	58
New Severn	56	00	88	20
Cape Henrietta Maria	55	07	84	30
Viner's Isle	53	05	84	03
Albany Fort	52	26	84	50
Moose River's Mouth	51	18	83	13
Point Comfort	51	24	81	11
Frenchman's River	51	20	80	14
Rupert's River	51	37	79	26
Chalton's Island	52	08	81	20
Danby's Island	52	15	80	56
Shepherd's Island	51	45	80	48
Solomon's Temple Island	53	35	81	00
Weston's Island	52	58	82	48
Cubb's Island	54	16	82	40
Bear's Island	54	25	83	45
Baker's Dozen's Island	57	56	81	25
Sleeper's Isles	60	10	81	30
Mansfield's Isle, the middle	61	42	80	30
Cape Jones	54	55	78	58
Cape Walsingham	62	35	77	55
Cape Charles	62	48	75	30
Button's Isle	60	25	66	27
Bell Island	52	07	55	35
Gray's Island	50	35	53	25
Cape St John	50	25	52	48
Penguin Island	50	00	50	50
Cape Bonavista	49	15	52	12

North Latitude

West Longitude

## The Sea-Coasts of Hudson's-Bay, Newfoundland, and New England.

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
Trinity Bay Entrance	48	52	52	20
Barcaleau Island	49	40	51	56
Conception Bay Entrance	58	20	52	08
Cape St. Francis	48	09	51	46
Cape Race	46	40	51	52
Bay of Bulls	47	50	51	29
St. John's Harbour	48	00	51	39
Cape St. Maria	47	10	53	23
Placentia Bay	47	45	53	58
Cape St. Laurenfa	47	30	54	23
Island St. Paul	47	10	58	18
Cape Roye	48	00	57	40
Virgin Rocks	46	06	51	07
French Factory	50	10	61	10
Bay of Brest	52	10	56	57
Tadoufack	49	00	67	05
Quebeck	46	55	69	48
Anti Costi Island, the Middle	49	40	69	45
Cape St. Charles, or Charles Straits	52	10	55	00
Cape Britain I. Scateri	46	08	58	30
Cape Sable	43	56	66	28
Point, or Port Royal	44	45	65	40
Penobscut River	44	40	67	10
North Yarmouth	44	14	67	58
Pascataway Entrance	43	26	70	10
Cape Ann Island	42	46	69	45
Cape Codd	42	15	69	25
Boston	42	25	70	37
Plymouth	42	02	68	50
South of St. George's Bank	41	45	67	15
South End of Nantucket Shoals	49	50	68	23
Nantucket Island	41	15	68	48
Martha's Vineyard	41	14	60	09

North Latitude

West Longitude

The Sea-Coasts on the Main Continent in the West-Indies

Names of Places.	Longitude		Longitude	
	D.	M.	D.	M.
Elizabeth's Island	41	35	69	13
Block Island	41	15	69	58
Montock Point	41	18	70	20
Fisher's Island	41	20	70	40
New York	40	42	74	14
Sandy Hook	40	28	74	15
Cape James, or Henlopen	38	48	75	28
Philadelphia	40	50	74	10
Cape May	39	00	75	15
Cape Charles	37	11	76	11
Cape Henry	36	58	76	23
Cape Hatteras	35	25	76	20
Cape Feare	33	58	76	50
Cape Roman, or Cattit	33	27	77	54
Ashley River, or Charles Town	33	05	78	46
Port Royal	32	00	79	43
Bay of St. Augustine	30	10	80	43
Cape Florida	24	57	80	30
Laphillapina, or Apalachia	29	47	84	44
River Spiritus Sanctus, or Mischi- sippi River's Mouth	28	54	96	50
Tompeck	22	20	100	15
Liva, or Vera Cruz	19	12	97	48
Sierra, or Cape de Martin	19	10	95	45
Triste, or Trieste Island	18	10	91	20
Campecha	19	20	92	10
Cape Condefedo	20	40	89	40
Cape Catocha	21	10	86	10
Salamancha	16	50	89	10
Cape Honduras	16	25	85	25
Cape Cameron	16	10	83	30

North Latitude

West Longitude

## The Coasts on the ain Continent in the West-Indies.

Names of Places.	Latitude		Longit.	
	D.	M.	D.	M.
Entrance of Nicaragua ———	11	25	85	15
Porto Bello ———	09	33	79	45
Darien, or Scotch Settlement ———	08	30	78	45
Carthagena ———	10	28	75	21
Cape Conquiquaco, or Coquibaco —	12	40	70	42
Island Curafoa, or Quicaso ———	12	10	68	15
Island Margaritta ———	11	20	63	20
Island Trinidad ———	10	15	60	17
Mouth of Oronoque River ———	08	15	59	25
Cape Three Points ———	10	30	62	10
Cape Nassau ———	07	55	57	55
N. Cape, the middle of Caopory Island	02	05	49	56
Suranam ———	06	25	56	50
Cape Orange ———	04	25	50	55
Mouth Amazonas River ———	00	00	49	56

North Latitude

West Longitude

## Islands in the West Indies.

Tobago West-end ———	11	20	59	52
Barbadoes, at Bridge-Town ———	13	08	59	50
Granada ———	11	57	60	20
Granadillos ———	12	20	59	55
Boquia ———	12	50	59	53
St. Vincent ———	13	12	60	12
St. Lucia ———	13	45	61	04
Martinica ———	14	43	60	54
Dominica ———	15	23	60	30
Marigallanta ———	15	58	60	20
Guardalupa ———	16	10	61	15
Desfeda ———	16	20	60	10
Antegua ———	17	05	61	45
Barbuda ———	18	06	61	40
Monferat ———	16	35	62	13
Rodondo ———	6	55	61	15

North Latitude

West Longitude

Islands in the West-Indies.

Names of Places.	Latitude		Longitude	
	D.	M.	D.	M.
Nevis	17	00	62	42
St. Christophers	17	17	62	50
Eustatia	17	25	62	20
Saba	17	35	62	40
St. Bartholomew	17	52	62	05
St. Martin's	18	06	62	10
Anguilla	18	17	62	13
Sambrero	18	35	62	30
Anegada	18	47	62	46
St. Cruz	17	55	65	52
Virgins	18	30	63	25
St. Thomas	18	30	63	22
St. John de Port Rico	18	30	65	37
Islands and Rocks of Aves	12	01	64	30
Tortuga, or Tortugas	11	10	63	54
Margaritta	11	16	63	36
Blanco	11	50	63	40
Tefligos	11	35	62	41
D'Orchila	11	45	64	30
Bonairy, or Bonaire	12	12	66	28
Aruba	12	50	68	28
East-end of Hispaniola	18	18	69	15
West-end of the same	18	26	74	36
East end of Jamaica	18	00	75	40
Port Royal Jamaica	17	50	76	32
West-end of the same	18	08	79	00
East-end of Cuba	20	15	74	50
Havannah	23	10	81	41
West-end of Cuba	21	40	86	30
La Bermudas	32	25	66	40
Bahama Island	26	50	78	36
Abaco South-end	26	00	75	05
Andrews, or Andros, or North-end	25	10	78	40
Providence	25	00	77	00

North Latitude

West Longitude

## Islands in the West-Indies

Names of Places.	Latitude		Longit.	
	D.	M.	D.	M.
Harbour Island	25	37	76	47
Eleuthera South-End, or Hathern	24	40	75	56
Cat Island, the Middle	24	25	75	09
Watling's Island	23	43	74	25
Rum Key	23	45	74	50
Exuma	23	22	75	55
Crooked Island, North-End	22	56	74	12
Long Island, South-End	22	41	74	52
Atwood's Key	23	10	73	35
Mayaguana	22	35	72	46
French Keys	22	40	73	40
Merapervouz	21	58	74	45
Hogfies	21	17	73	55
Hineago, West-End	20	25	73	49
West Caicos	21	38	71	58
Turk's Island	21	35	70	08
Abrollo Bank, the North-End	21	35	69	46
Plate Rack	20	10	68	15
Mucacres	21	30	76	35
Verd	21	17	76	16
Cajad.Zal	23	10	79	24
Pinos	21	20	84	20
Great Camains	18	54	81	29
Little Camains	19	30	80	24
St. Andero	12	33	81	27
Caimanubiack	19	08	80	11
Pedro Shoals, North Side	17	10	77	56
St. Milan	17	10	81	28
Guayna	16	53	88	30
Cozumelli	19	30	89	05
Zuna Quita	17	01	89	48
Mexico	20	00	103	35

West Longitude

North Latitude

These following were settled from Observations of the Moon's Distance from the Sun and Stars, made by Messrs. W. WALES, F. R. S. and W. BAYLY, Astronomers, during Captain Cook's Voyage towards the South Pole, and round the World, in His Majesty's Ships the *Resolution* and *Adventure*, in the Years 1772, 1773, 1774, and 1775.

Names of Places:	Latitude		Longit. fr. Lond.	
	D.	M.	D.	M.
C A P E of Good Hope	33	55	18	25
Dufky Bay, New Zealand	45	47	166	20
Charlotte's Sound, new Zealand	41	06	174	22
Point Venus, Otaheite	17	29	210	26
I. Ohitahoo, one of the Marquisas	9	55	220	54
I. Tanna, one of the New Hebrides	19	32	169	47
I Pudyoua, New Caledonia	20	18	164	44
Christmas Sound, Terra del Fuego	55	22	290	00
C. Desolation	55	13	288	37
York Minster	55	31	290	18
C. Horne	55	59	292	37
I. Uliatea	16	45	208	26
I. Huahaine	16	45	208	51
I. Eaoowe, or Middleburg	21	21	185	29
Tonga Tabu, or Amsterdam, friendly Isles	21	04	185	13
Pylestaert Island	22	23	184	15
Tolago Bay	38	21	178	36
Portland	39	35	178	15
Mew Stone off Van Diemens Land	43	48	146	30
Adventure Bay in Ditto	43	23	147	33
Cook's Streights	40	48	175	07

South Latitude  
East Longitude

Names of Places.	Latitude		Longit. fr. Lond.	
	D.	M.	D.	M.
C. Pallisser, N. Zealand	41	35	175	03
Easter I. North-west Side	27	08	250	11
Resolution Bay, Ohitahoo, one of Marquisas	9	55	220	57
Bolabola	16	32	208	11
Savage Island	19	02	190	32
Turtle Island	19	49	182	6
Annamocka, one of the friendly Isles	20	15	185	32
Mallicola, Sandwich Harbour	16	24	167	53
Cape Quiros, Terra del Espiritu Sancto	14	56	167	23
Botany Island	22	26	167	20
East Cape of Staten Island	54	54	295	16
South Thule	59	34	332	18
Cape Montagu, N. 45 E.	58	33	333	17
Harvey's Islands	19	16	201	16
Howe's Island	16	46	205	56
Palmerston's Island	18	00	197	06
Southern King George's Island	14	34	212	44
Pallisser's Isles	15	38	213	33
Taoukaa	14	29	214	53
Friendly Isles, sundry, which extend from	19	37	185	10
to	20	32	185	50
Aurora, North End	14	52	168	16
Whitsuntide Isle, N. End	15	28	168	24
Maskelyne's Islands	16	30	168	00
Shepherd's Islands	16	56	168	44
Sandwich's Island	17	29	168	25
Hinchinbrook Island	17	25	168	38
Montagu Island	17	26	168	33
Traitor's Head	18	43	169	23
St. Bartholomew Island	15	42	167	20
Cape Cumberland	14	39	166	50
Cape Colinet	20	30	164	59
Cape Coronation	22	05	167	11
Queen Charlotte's Foreland	22	15	167	15
Isle of Pines	22	38	167	41
Norfolk Island	29	02	168	13
Cape Disseada	53	04	285	45

South Latitude

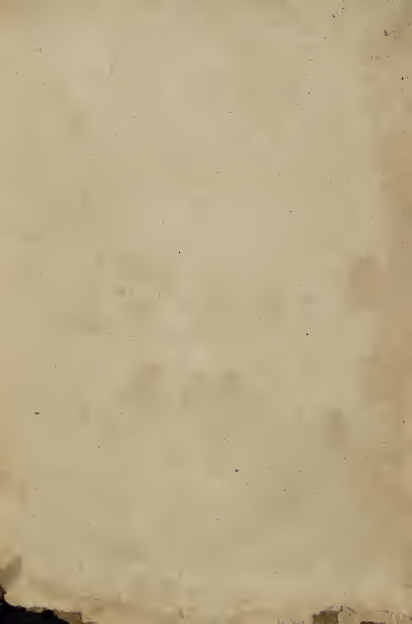
East Longitude



Names of Places.	Latitude		Longit. fr. Lond.	
	D.	M.	D.	M.
Cape Noir	54	32	287	59
St. Ildefonso's Isles	55	51	290	35
Evout's Isles	55	34	293	04
Cape St Diego	54	33	294	49
New Year's Harbour, Staten Land	54	48	295	52
Cape St. Juan	54	47	296	16
Willis's Isles	54	00	321	33
Cape North	54	05	321	48
Cape Saunders	54	06	323	05
Cape George	54	17	323	30
Cape Charlotte	54	32	323	51
Clerke's Isles	55	05	325	21
Friezland's Peak	59	02	333	07
Saunders Isle	58	00	333	05
Candlemas Isles	57	10	332	50
St. Helena	15	55	5	49
Island Ascension	07	57	14	27
Isl. Ferdinando de Noronha	03	56	32	20
Fayal, Villa de Horta	38	32	28	30
Porto Sancto	32	58	16	22
Madeira, Fonchal	32	33	17	8
Palma, middle	28	36	17	57
Ferro Isle, South End	27	42	18	6
Bonavista, N. End	16	14		
Terceira	39	14	27	22
St. George	38	47	28	42
Mayo, South End	15	11	23	7
St. Jago, Port Praya	14	54	23	26
Kamptfchatka Nos }				
Per Krinshonicicoff }	56	10	198	36
Drake Point, California	38	45	128	35

If the Longitude be reckoned Eastward and exceeds 180, subtract it from 360, the Remainder is the Longitude West, and vice versa.







232

152